ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Vol. XXXIII, No. 20.

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The Harlem River ship canal, connecting the waters of the Hudson and East Rivers, is to be formally opened to traffic on June 17 next, with speeches and a water parade.

A bill appropriating $8,000 for a survey of the upper Hudson River valley has been signed by Governor Morton. It provides.

That the State Engineer and Surveyor and the State Superintendent of Public Works shall, as soon as practicable, cause a survey to be made, with a view to determining what lakes and streams may be improved, and the waters thereof stored or diverted, in order to provide for an enlargement of the Champlain Canal; for restoring to the water power of the Hudson River at or below Glens Falls, the water diverted therefrom for canal purposes and for improving the navigation of the lower Hudson River. They are to locate the particular sites for dams, establish the lines of flow for securing the full storage available at the various reservoir sites such survey may disclose, and make careful estimates of the cost of constructing such dams or reservoirs, and the amunot of stored water that will result from the full development thereof.

The bill providing for an increased tax levy, recently introduced into the Illinois State Legislature by the Board of Trustees of the Sanitary District of Chicago, will, according to present indications, become a law, with the addition of some slight amendments, made to satisfy the demands of the towns along the Desplaines River valley. This bill was prepared by the Board of Trustees of the Sanitary District, as noted in our issue of April 18, and it asked that the district be allowed to levy for a period of three years a tax of 1½%, instead of ½%, so as to secure the additional money required for constructing the Drainage Canal. The people of Joliet, Peoria, and other towns in the Desplaines and Illinois River valley, through which the water of the Drainage Canal will flow, introduced a substitute bill, providing that the increased tax should run for six years, instead of three, that the navigable channel should be continued from Lockport to Joliet, at a cost of several millions of dollars, that swing bridges should be constructed at all crossings of the canal, and that a volumne of 300,000 cu. ft. of water per minute should debouch from the canal continuously, whether the Desplaines and Illinois rivers were at a flood or at low water. This substitute bill was fought by the Sanitary District, and finally a compromise was agreed upon between the District and the valley towns. The compromise consisted in adding to the Board of Trustees' bill an amendment regarding the quality and character of the water flowing through the canal. As we shall have something to say regarding this question in a future issue, the amendment is given in full as follows:

Any channel or outlet constructed under the provisions of this act which shall cause the discharge of sewage into a river or stream of water beyond the limits of the drainage district shall be of sufficient size and capacity to produce a continuous flow of water of at least 200,000 cu. ft. a minute for each 1,000,000 population of the district drained thereby, and the same shall be kept and maintained of such size and in such condition that the water thereof shall neither be offensive nor injurious to the health of any of the people of the state, and before any sewage shall be discharged into such channel, all garbage, dead animals, or parts thereof, and other solids shall be taken therefrom, and said district shall at the time any sewage is turned into such channel turn into it not less than 20,000 cu. ft. for every 100,000 inhabitants of the district, and shall thereafter maintain the flow of such quantity of water.

An ocean-going hydraulic dredge is being built for the United States government by the Bucyrus Steam Shovel & Dredge Co., of South Milwaukee, Wis., which is unusually large and complete in its equipment. The dredge is equipped with two centrifugal pumps, each having a capacity of 300 cu. yds. of sand per hour. These pumps deliver the sand into the internal hoppers of the vessel, which have a capacity of 600 cu. yds. The vessel is a complete ocean-going steamship in every particular, being equipped with compound engines of 500-HP., which enable her to steam at a speed of ten knots per hour. Her equipment also includes two powerful electric searchlights. This vessel is intended for the harbor work at Galveston, Texas, now in progress under the direction of Maj. A. M. Miller, U. S. Engineer Corps, and is expected to be ready for operation about June 1. The dredge is constructed throughout from the designs of Mr. A. W. Robinson, M. Am. Soc. C. E., Chief Engineer, Bucyrus Steam Shovel & Dredge Co. We hope to give a complete description of this machine in a future issue.

Oval, instead of circular, turrets are proposed for the battleship "Iowa," and the question of shape is now before Secretary Herbert for decision. The inside diameter of the circular turret originally proposed was 26 ft. The dimensions of the oval turrea would be 26 × 19 ft. The advantages claimed for the latter are—less surface exposed to the enemy's fire by 7 ft.; better balance in the turret in heavy weather, and the possibility of increasing the port plates 2 ins. in thickness, with a total decrease in weight. In other words, instead of having a circular turret 15 ins. thick, the side of the oval turret exposed to attack can be made 17 ins. thick. The proposed change has been approved in part by Capt. Sampson, Chief of the Bureau of Ordnance.

An actual ballistic test of an armored turret is proposed, at Indian Head, to settle questions of resistance, effect and construction. The one-sixth of a turret would be set up, with its 8 ins. of oak backing and ⅝-in. steel lining. The ordnance experts expect to prove by this experiment that the backing must be made to fit the armor; and that it is an element of weakness to piece out the armor by a wedge-piece, as has been done in several cases. They claim that this "filler" would be dislodged in action; the constructors, on the other hand, say this wedge in nowise impairs the efficiency of the turret. The experimental turret will be arranged to test the effect of firing on a similar wedge.

The two American armor-making firms have practically completed the original contracts entered into with the United States government. The Bethlehem Iron Works obtained the first contract on June 1, 1887; since that time it has created a plant and made and delivered 6,400 tons of armor plate. The Carnegie Company obtained its first contract on Nov. 20, 1890, and, under similar previous conditions, has made and delivered 6,000 tons of material. Under a contract of 1893 both of these companies still have considerable material yet to deliver, but it is expected that by October of this year, or earlier, all will be finished. The contracts for the vessels lately authorized by Congress have yet to be made. These will call for about 5,000 tons for the two battleships, and 100 tons, or a little more, for the 2½-in. sponsoa armor of the eight gunboats. The battleship armor will be Harveyized nickel-steel.

Shells loaded with high explosives were fired, on May 11, at Sandy Hook, from a 15-in. gun converted from an iron smooth-bore by rifling. The first test was made with 117 lbs. of gun-cotton mixed with paraffine and carefully packed in a steel shell; with a powder charge of 124 lbs. this projectile was fired with satisfactory results. In a second test, 230 lbs. of gun-cotton were fired with similar results. In the third test 230 lbs. of emmensite were loaded into a steel shell, and the gun was fired, as before, by electricity. In this case the explosive was too sensitive; the shell exploded in the gun, tearing it and the carriage into fragments, and making a hole in the ground 10 ft. deep and 25 ft. in diameter. Previous to this test charges of 25 to 30 lbs. of emmensite had been discharged from smaller guns with uniformly successful results. The present verdict is that it is too sensitive to be used in large charges. The whole test was important as involving the handling of the largest charges of high explosives ever tested in this manner.

The most serious railway accident of the week was a derailment May 11 on the Lehigh Valley R. R. on the meadows near Newark, N. J. A freight train of 30 cars was derailed by an open switch, and the engine was overturned and several cars wrecked. Two men were killed and three seriously injured. The wreck caught fire and 15 cars were burned.—One car of the eastbound freight train on the Lake Erie & Western R. R. jumped the track near Celina, O., May 7, and caused a wreck. Two men were killed and two injured.

A small trestle on the Wheeling & Lake Erie R. R. near Massillon, O., gave way under a wrecking train May 10, and one man was killed and three were injured in the wreck. Several bridges had been weakened by floods, and the wrecking train was starting out to make repairs.

A serious accident occurred on the Welland Canal May 9, when the steamer "Jack" carried away the four gates of Lock No. 22 and one gate of Lock No. 21, near Port Colborne, Ont. The break in the canal is the most serious that has occurred in many years. The banks of the canal are torn away in many places, and the roadbed on the Grand Trunk Ry. at the tunnel is washed out badly. Earth from the canal banks covers the rails for half a mile. The captain, who was on the bridge, states that he gave the signal to go astern, but the engineer mistook the signal and kept the engines going ahead.

An explosion of natural gas occurred in a tenement house on Sherman St., Chicago, May 11, by which two persons were killed and eleven seriously injured. The building was badly damaged.

An explosion of compressed city gas, used for car lighting, occurred in the Jersey City station of the Pennsylvania R. R. about 8:40 p. m., May 11. The flexible hose used for charging the car reservoirs burst or was cut, and the escaping gas caught fire at a hand lamp and exploded, tearing up part of the platform and smashing a number of car windows. Nobody was hurt. The gas is used for Pullman cars running on the Atlantic Coast Line route, and is compressed to about 300 lbs. per sq. in., the pressure in the reservoirs being about 250 lbs., or nearly double that used with the Pintsch compressed oil gas.

Jersey City will probably ask new bids for a water supply within a short time. On May 9 the Finance Board non-concurred in the award made by the Street and Water Commissioners to the Jersey City Water Co. for a gravity supply from the Rockaway River, under the bids of March 25, 1895. The principal grounds for non-concurrence were the inadequacy of the watershed offered and the high prices demanded. The Finance Board expressed itself on the above date in favor of another call for proposals "upon plans so simple and broad as to permit the widest competition."

The filtration of the water supply of Hoboken, N. J., is advocated by the mayor of that city, Mr. Lawrence Fagan, in his annual message. The contract with the Hackensack Water Co. expires soon and the mayor recommends that any new contracts "shall call for water that has been filtered through sand." The city owns the mains and buys Hackensack River water from the above company. The mayor states that the water compares very favorably with that of adjoining cities and that there are but few cities which have filtered water, but he thinks that the question of pure water is so important as to demand the action recommended.

A railway contractor's suit, recently decided at Cincinnati, O., is of interest to contractors generally. The case was that of the Central Trust Co., of New York, against the Richmond, Nicholasville, Irvine & Beattyville Ry. Co., of Kentucky. The contractors who built the road and the men who furnished materials filed liens against the railway property in the manner required by the Kentucky statute. Under the decision of the Circuit Court they were allowed their claims in full, but without interest. By the decision of the U. S. Circuit Court of Appeals, just rendered, the contractors are also allowed interest on their entire claims from the time they became due. The Richmond & Irvine Construction Co., which undertook to complete the road to Irvine, Ky., after the railway company had become insolvent, was not allowed its claim in full, though the amount it will realize on its claim is materially increased by the decision. These cases have been in progress for over four years, and involve the construction of a new railway lien law in Kentucky. The real controversy was between the mortgage bondholders and the contractors, and the decision subordinates the lien of the bondholders to that of the contractors in every particular. The original contractors for the construction of this road were D. Shanahan, Sons & Co., of Louisville, Ky., and their lien amounts to $200,000.

A gift of $1,000,000 has been made to Columbia College by its President, Mr. Seth Low, and another gift of $300,000 has been made by Mr. W. C. Schermerhorn.

THE CHICAGO MAIN DRAINAGE CHANNEL.

I.

(With Inset.)

History of the Work.

The first effort to provide the city of Chicago with a sewerage system was made in 1855, when the Illinois Legislature passed a bill creating a Board of Sewerage Commissioners, to be appointed by the City Councils. The late E. S. Chesbrough, M. Am. Soc. C. E., the father of sanitary engineering in this country, was made the chief engineer of the first commission appointed by the authority of this act, and soon after his appointment he set energetically at work on the problem which he was called upon to solve. The full difficulties of the problem presented at that time can hardly be realized at the present day. The systematic sewerage of cities, as that term is now understood, was then unknown in this country. Cesspools were regarded as the proper receptacles for house drainage and sewers simply as channels for carrying off the surface water.* Not only was the engineer able to profit little by the experience of other cities, but the local conditions were unfavorable. The area which it was proposed to drain (roughly what is now comprised between Chicago Ave. and Twelfth St., on the north and south, and Lake Michigan and Halstead St., on the east and west) was only 12 or 14 ft. above the lake at the higher points and from this elevation the surface descended irregularly to a height of only 3 or 4 ft. above the lake, in the vicinity of the Chicago River. This necessitated raising the grades of the streets and filling in large areas of low land, in order to keep the sewers under ground.

The first step taken by the Board of Sewerage Commissioners was to call for plans and suggestions. There were 39 plans submitted in answer to this request, and although none of them were adopted, they furnished many hints and suggestions to the Board. In the last part of December, 1855, Mr. Chesbrough made his first report,** outlining a complete sewerage system. Briefly stated, the plan proposed was to discharge all of the sewage into the Chicago River through mains placed in alternate streets running to the river, or about 800 ft. apart, into which the laterals from the side streets were to empty. The main sewers were from 3 ft. to 6 ft. in diameter and the laterals 2 ft. in diameter, and all were to be constructed of brick. For the purpose of flushing the sewers, it was proposed to lay lines of water pipe, which were to be supplied with water pumped from the lake or the Illinois & Michigan Canal, according to their location. The engineer also realized that the Chicago River could hardly be kept fresh with all this sewage flowing into it, unless some means of flushing it could be provided. Accordingly, the plans provided for a canal 20 ft. wide and 6 ft. deep, with timber sides, along 16th St. from the lake to the river, through which water could be forced into the upper part of the South Branch.

As indicating the thoroughness with which Mr. Chesbrough had studied the problem, it may be noted that he at that time considered that ultimately it would be necessary to construct an outlet to the southwest for carrying away the city's sewage and for that reason discharged none of his sewers directly into the lake. He, however, realized that such an outlet was not warranted at that time, and provided for the discharge of the sewers into the South Branch, which could at any future time be connected with an outlet to the southwest, but would temporarily carry the sewage into the lake. Another point worthy of note is the fact that none of the sewage was to be discharged into the North Branch of the river as long as the population could be accommodated by the sewers entering the South Branch. In other words, the engineer realized that some means of flushing the North Branch would have to be provided as soon as any great quantity of sewage began to flow into it. Such provision had been made for the South Branch by means of the 16th St. canal, and as long as all of the sewage could be discharged into it, there would be no need of building an expensive canal for flushing the North Branch.

As finally constructed the sewerage system differed considerably from the original plans. The more important of the changes were: The omission of the flushing pipes and the 16th St. canal, and the discharge of several of the sewers directly into the lake. It should be noted that the construction of the great drainage channel, now under way, will not correct this original error of emptying part of the sewers into the lake, an error which it is also worth noting was made against the advice of the engineer.

The first trouble, however, did not arise from the sewers entering the lake, but from the gradual accumulation of filth in the South Branch of the Chicago River. This accumulation the engineer had intended to prevent by constructing the 16th St. canal, but, as already noted, for some reason the commissioners had deemed it inadvisable to construct this canal. This offensive condition of the South Branch seems to have first attracted official attention in 1860, for the records show that in that year the Board of Sewerage Commissioners ordered Chief Engineer Chesbrough to investigate means for alleviating the nuisance and especially to find out what the chances were of getting rid of the foul water by the Illinois & Michigan Canal. This canal had been completed in 1847 from the Chicago River, at Bridgeport, to the Illinois River, at La Salle, 100 miles, and secured part of its water for the summit level in times of drought by pumping form the Chicago River at Bridgeport. This pumping was necessary for only about 45 days out of the year, but it had done much toward relieving the river from its filth at those times, and Mr. Chesbrough argued that until some more efficacious plan should be decided upon, the city should pay the canal officials to pump from the river enough water to keep it inoffensive, whether they needed the water for the summit level or not. He was probably led to urge this temporary expedient by the hope that the talk of cutting down the summit level of the canal, so that all the water for its supply could come from Lake Michigan, would materialize into some definite plan for the work. Of course, if a good current was set up in the South Branch and west through the canal by this cutting down of the summit level, the whole question which was troubling the city was settled.

It is worth noting that the complaints of the foulness of the river arose first not on account of the contamination of the water supply, but on account of the offensive odor. In the early winter of 1862, however, a combination of high water in the river and a southeast wind lowering the lake level, caused a very large amount of the river water to enter the lake, and complaints immediately arose of the foul smell and taste of the water supply. Despite the pumping into the canal, this nuisance became of increasing frequency, and finally in 1864-5 the city and the canal officials came to an agreement whereby the summit level was to be cut down, and all the water drawn from the lake. Work was begun in 1865, and, after many delays, was completed in 1871.

All this work had been done to relieve the South Branch, and, indeed, it was not until nearly 1870 that any trouble began with the North Branch.

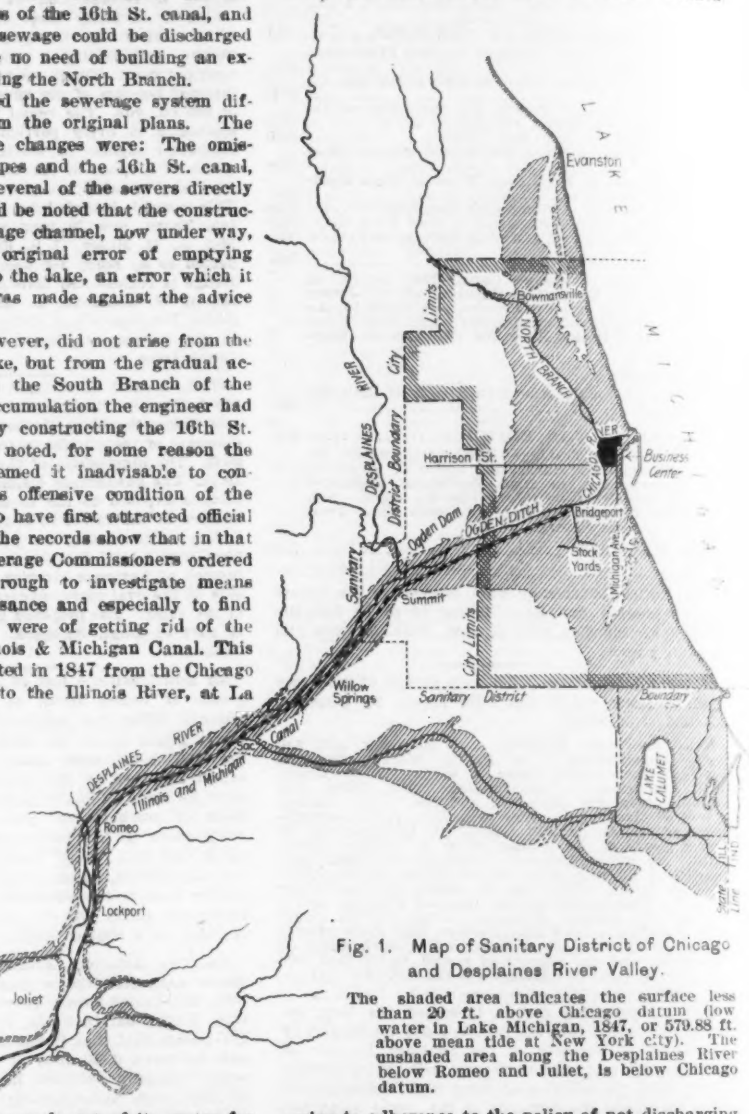


Fig. 1. Map of Sanitary District of Chicago and Desplaines River Valley.

The shaded area indicates the surface less than 20 ft. above Chicago datum (low water in Lake Michigan, 1847, or 579.88 ft. above mean tide at New York city). The unshaded area along the Desplaines River below Romeo and Juliet, is below Chicago datum.

owing to adherence to the policy of not discharging sewage into it until it was absolutely necessary. In 1870 only about 5% of the total sewage of the city entered the North Branch, but numerous distilleries and tanneries had been erected along its banks, and the waste from them was rapidly making the water as foul as that of the South Branch. The deepening of the canal was expected to cleanse the South Branch, but it would not help the North Branch. It was decided, therefore, to construct a conduit from the lake to the upper waters of the North Branch, and pump water into the river or into the lake through this conduit, as might be required, for the purification of the river. This conduit was built along Fullerton Ave., and is known as the Fullerton Ave. conduit.

The Fullerton Ave. conduit was completed in 1880, nearly six years after work was first begun. It was a brick tunnel 12 ft. in diameter, and 11,898 ft. long. The bottom of the tunnel from the river to Racine Ave., 4,270 ft., was level and 13 ft. below datum. A short distance east of Racine Ave. it dropped to a grade 27⅞ ft. below datum, and thence continued in a series of descending grades to the lake shore shaft, where it was 54½ ft. below datum. From this point to the lake shaft, 1,000 ft., the conduit was level. The pumping machinery was at the river, and consisted of two screws similar to an ordinary propeller, which were fixed on a horizontal shaft and operated to force the water in either direction. The rated capacity

* In England up to the year 1815 it was penal to discharge sewage or offensive matters into the sewers. Afterwards it became permissive, and in the year 1847 the first act was obtained making it compulsory to drain houses by sewers.

** The full text of this report was published in Engineering News for the months of April, May and June, 1875 (Vol. II., pp., 42, 55 and 70). The report was made after a visit to the sewerage systems of Europe, probably the earliest visit, and the first report of this kind made by an American engineer. As long ago as 1875, when the report was reprinted in this journal, copies of it were not available and it was necessary to transcribe it in the office of Mr. Chesbrough. An abstract of the report is given in Rafter and Baker's "Sewage Disposal in the United States," pp. 172-3, and also a more extended description than can be presented here of the efforts to purify the Chicago River prior to the inception of the great drainage canal.

of these screws was 24,000 cu. ft. per minute. How this conduit operated for the purpose intended will be noted later.

Returning now to the deepening of the Illinois and Michigan Canal in 1871, it was of course expected that when the work was finished there would be no further trouble, and indeed for some months everything worked charmingly. Difficulties were approaching, however, from several directions. It was soon discovered that the difference between the level of the canal at the summit and at the lake was so small and the current west so slow, that a southwest wind lowering the lake level would change the current to run east. A very heavy rainfall would also fill the canal and set the current east. At the best the current was sluggish. The greatest trouble, however, arose from the construction of the Ogden-Wentworth Canal. This canal was built partly for drainage purposes, by which the low-lying land along the Desplaines River north of Summit could be reclaimed, and partly to supply additional dock and harbor facilities. It was entirely a private enterprise. The canal was, in fact, an extension of the West Fork of the South Branch west to a connection with the Desplaines River just north of Summit, or just where the waters coming from the north turn west towards the Illinois River valley. The result of this canal was that a very considerable part of the waters of the Desplaines, instead of flowing west by the natural channel, came east by the new canal, and, emptying into the South Branch of the Chicago River, caused a current east. In other words, the Ogden-Wentworth Canal undid all the work which had been done in deepening the Illinois & Michigan Canal, as far as its effect upon the purification of the river was concerned.

A long and bitter wrangle arose between the owners of the canal on one hand and the city and state officials on the other regarding the right of the canal people to construct and use their canal. This dispute was finally patched up by an agreement for the construction of a dam which would prevent the waters of the Desplaines from entering the canal at all times. The first dam was built in 1877, and in 1885 a new dam was constructed. This dam, however, restrained the water from flowing into the Chicago River only at the low stages of the Desplaines River. As a matter of fact, at times of high floods 75% of the Desplaines River waters came through Chicago as they did before dams were built. It was found, however, that something had to be done to maintain the current west through the South Branch of the Chicago River and the Illinois & Michigan Canal, and after much study it was decided to rebuild the old pumping works at Bridgeport which had been removed after the deepening of the Summit level.

Meanwhile, the Fullerton Ave. conduit had not done what it was expected to do, that is, keep the North Branch clear of offensive sewage. As soon as it was finished the city began to discharge sewage into the North Branch, and the waters here soon became almost as filthy as those of the South Branch. To be sure, the conduit had delayed the fouling of the water, but it could not prevent it in the end. Neither had the Bridgeport pumping plant succeeded in benefiting the condition of the South Branch much. The city of Chicago therefore found itself, at the end of 1880, after 25 years of struggling to get rid of its sewage and preserve its water supply uncontaminated, looking for some means of purifying the waters of this river from its filth and preventing a repetition of the great epidemics of 1848 and 1854, which had led to the construction of the first system of sewers.

In 1880 the Citizens' Association of Chicago, through the papers and printed pamphlets, began the work of creating and fostering a public sentiment which should demand better drainage for the city. This agitation resulted in the creation of a Drainage & Water Supply Commission by the City Councils in January, 1886. The first commission was appointed immediately by Mayor Carter H. Harrison, and consisting of Mr. Rudolph Hering, M. Am. Soc. C. E., as Chief Engineer, and Mr. Benezette Williams and Mr. Samuel G. Artingstall, Mem's. Am. Soc. C. E., Consulting Engineers. This commission made a thorough study of the conditions and presented a preliminary report in January, 1887. Owing to lack of funds, no final report was ever presented. Summed up in the fewest words, the report recommended the construction of a canal to carry the sewage diluted with water from Lake Michigan west into the Desplaines River, and thence into the Mississippi River.

As a result of this report two bills providing an adequate system of drainage for the city of Chicago were introduced into the Illinois State Legislature at the session of 1886-7. One of these was known as the Winston bill, and provided for raising the money necessary for constructing the proposed channel by special assessment on the property benefited. The other bill was known as the Hurd bill, and created a metropolitan district with power to issue bonds based on taxation to construct the required works. After several months' study by the Senate and House Committees, and then by a special commission of two members each of the House and Senate and the Mayor of Chicago, the Hurd bill, in a slightly modified form, was passed by the legislature and became a law July 1, 1889. Under this law the boundaries of the Sanitary District of Chicago were fixed Oct. 14, 1889, and the first Board of Trustees was elected Dec. 12, 1889.

Passing over the numerous internal dissensions with which the trustees frittered away the best part of two years with nothing definitely accomplished, we will endeavor to trace briefly the work of selecting a route for the proposed channel. It is the accepted geological teaching that the Great Lakes at one time emptied into the Gulf of Mexico,

TABLE I.—GIVING NAMES OF CONTRACTORS, CUBIC YARDS OF EXCAVATION AND PRICE PAID FOR EXCAVATION FOR EACH CONTRACT SECTION OF THE CHICAGO MAIN DRAINAGE CHANNEL, COMPILED FROM THE LATEST ESTIMATES (DEC. 31, 1894) OF THE ENGINEER CORPS OF THE SANITARY DISTRICT OF CHICAGO.

Note.—The totals of cost in the last column include all the miscellaneous constructions, as trestles, riprap, etc., of each section.

Names and addresses of contractors.	Section.	Glacial drift. Main channel cu. yds.	Glacial drift. Price per cu. yd., cts.	Glacial drift. River diversion, cu. yds.	Rock. Cu. yds.	Rock. Price per cu. yd., cts.	Retaining wall. Cu. yds.	Retaining wall. Price per cu. yd.	Total cost.
Brighton Division.									
McMahon & Montgomery, 425 N. Halsted St., Chicago.	O	1,648,743(a)	21	.....	.....	..	.....	....	$344,783
Hayes Bros., 32d St. and Maplewood Ave., Chicago...	N	1,113,843	23	.....	.....	..	.....	....	256,184
The Heidenreich Co., the Rookery, Chicago.....	M	722,850	21.7	.....	.....	..	.....	....	156,588
" " " " " "	L	1,101,881	19.7	.....	.....	..	.....	....	217,071
Christie & Lowe, N. Y. Life Bldg., Chicago.....	K	1,155,957	25	.....	.....	..	.....	....	288,989
" " " " " " "	I	1,128,849	25	.....	.....	..	.....	....	284,062
Totals for Brighton division.....		6,873,123	..	.....	.....	..	.....	....	$1,548,848
Summit Division.									
Gahan & Byrne, Summit, Ill.	H	1,077,032	29	.....	.....	..	.....	....	$312,339
" " " " "	G	1,363,975	28	.....	.....	..	.....	....	381,941
Weir & McKechney, Summitt, Ill.....	F(b)	1,003,653	29½	66,914	16,724	90	.....	....	348,749
Angus & Gindele, Summit, Ill.....	E	1,813,659	27	74,334	78,765	70	.....	....	(c)606,613
E. D. Smith & Co., Romeoville, Ill.....	D	1,877,721	26 7-16	.....	137,694	100	.....	....	636,997
Western Dredging & Improvement Co., Summit, Ill....	C	1,887,755	23½	.....	.....	..	.....	....	486,319
Totals for Summit division.....		9,113,795	..	141,248	233,183	..	.....	....	$2,772,959
Willow Springs Division.									
Heldmaier & Neu, Mount Forest, Ill.....	B	1,576,828	27	212,210	.....	..	.....	....	$485,120
" " " " " "	A	2,576,508	30⅝	271,855(d)	4,188	80	.....	....	913,739
Griffith & McDermott, Willow Springs, Ill.....	1	1,173,751(f)	42.9	174,655(e)	536,024	80	66,967	$2.90	1,283,190
McArthur Bros., W. C. T. U. Temple, Chicago.....	2	729,489(g)	50	119,233(h)	472,624	80	37,668	3.25	922,256
Gilman & Co., Willow Springs, Ill.....	3	417,624(i)	56	.....	764,358	76	13,307	3.25	836,760
McArthur Bros., W. C. T. U. Temple, Chicago.....	4	999,655(k)	49	106,803	359,677	80	58,564	3.25	1,022,199
Totals for Willow Springs division.....		7,464,355	..	884,756	2,136,071	..	176,506	....	$5,466,275
Lemont Division.									
The Qualey Construction Co., Sag Bridge, Ill.....	5	1,064,021	27	.....	.....	..	73,424	$3.25	$765,746
Mason, Hoge & Co., Romeoville, Ill.....	6	685,156	27	118,808	549,118(l)	73½	33,736	3.25	755,530
" " " " " "	7	184,535	26	97,930	931,307(m)	74½	3,957	3.25	827,485
Mason, Hoge, King & Co., Romeoville, Ill.....	8	43,576	26	57,867	1,262,749(n)	74⅝	.....	....	1,028,130
Halvorsen, Richards & Co., Lemont, Ill.....	9	73,693	26	40,741	1,022,310(o)	76.9	.....	....	820,185
E. D. Smith & Co., Romeoville, Ill.....	10	31,104	25	30,310	1,199,546(p)	80	.....	....	1,022,850
Totals for Lemont division.....		2,082,105	..	345,655	4,965,030	..	119,052	....	$5,219,929
Lockport Division.									
Mason, Hoge & Co., Romeoville, Ill.....	11	44,032	30¼	11,739	1,001,183(q)	79¼	.....	....	$840,519
" " " " " "	12	60,000	30¼	11,739	1,000,500	73	10,000	$3.50	857,007
" " " " " "	13	35,000	26	.....	1,053,700	74¾	20,000	3.50	866,740
Smith & Eastman, Lockport, Ill.....	14	379,255	36(r)	.....	1,023,500	73	22,000	3.25	928,593
Wright, Meysenberg, Sinclair & Carry, Lockport, Ill..	15	36,000	19	.....	639,700	59	37,400	2.35	472,453
Totals for Lockport division.....		554,287	..	17,495	4,718,583	..	89,400	....	$3,965,012
Grand totals for 29 sections under contract.....		26,087,665	..	1,380,154	12,052,867	..	384,958	....	18,973,025
					Estimated cost of work contemplated but not contracted for..				3,883,899
					Cost of right of way				2,000,000
					Cost of administration				1,828,238
					Estimated total cost of canal.....				$27,303,216

(a) 132,000 cu. yds. collateral channel at 19.9 cts. per cu. yd. (b) 504,293 cu. yds. of the main channel and all of the river diversion channel were excavated by the first contractors, Ricker, Lee & Co., at 23¾ cts. per cu. yd. The figures of totals in the last column are obtained on the basis of 23¾ cts. per cu. yd. for the entire work. (c) This is figured on original prices of first contractors, Streeter & Kenefick. (d) 122,342 cu. yds. of this was material dredged from Desplaines River bed. (e) 10,162 cu. yds. of this is classed as river improvement. (f) 109,540 cu. yds. of this was excavated for 27 cts. and 11,926 cu. yds. for 30⅝ cts. (g) 29,625 cu. yds. of this was excavated for 28 cts. per cu. yd. (h) 29,516 cu. yds. excavated at 28 cts. per cu. yd. (i) 73,310 cu. yds. of this was excavated for 27 cts. per cu. yd. (k) 48,593 cu. yds. excavated for 27 cts. per cu. yd. (l) 17,857 cu. yds. river diversion. (m) 43,088 cu. yds. river diversion. (n) 90,434 cu. yds. of this river diversion. (o) 16,894 cu. yds. river diversion. (p) 58,276 cu. yds. river diversion. (q) 11,483 cu. yds. river diversion. (r) 166,210 cu. yds. at 20 cts. per cu. yd.

and perhaps at a still earlier date were an arm of the great southern sea bordering the North American continent and extending up through the present Mississippi Valley. As time passed and the southern ocean receded toward its present boundaries, the lake waters lowered until finally the gradually decreasing stream toward the Gulf of Mexico ceased altogether, and the entire outlet of the inland waters was through the St. Lawrence River. It is unimportant for the present purpose to trace the causes and progress of this movement, but the action left a rock-hewn trough through the watershed between Lake Michigan and the Mississippi Valley which is now occupied in part by the Desplaines River. This trough is indicated in a general manner by the maps Fig. 1 and Fig. 2, and of course was the route which naturally suggested itself for the canal.

The selection of a canal route in this limited available territory should have been one of no very great difficulty had the engineers been allowed to go at the work in a business-like manner, but this was not done. In the first place, Mr. L. E. Cooley, the first Chief Engineer, was interfered with in his surveys and ordered to report a route without sufficient time to secure the necessary information upon which to base plans and estimates. This he refused to do, and finally resigned his office. Mr. Wm. E. Worthen M. Am. Soc. C. E., was then appointed Chief Engineer, and he submitted two routes in a report dated Jan. 10, 1891. The Trustees adopted one of these routes April 4, 1891, but did nothing further. Mr. Worthen resigned his office soon after, and Mr. Samuel G. Artingstall, M. Am. Soc. C. E., was appointed Chief Engineer. Mr. Artingstall surveyed and submitted to the Trustees four routes, and on Sept. 16, 1891, the ordinance of April 4 was annulled and one of these routes was adopted, but no further action was taken. Three of the Trustees then resigned, and in November others were elected to fill the vacancies, and the new Board of Trustees was organized Dec. 8, 1891. On Jan. 16, 1892, Mr. Artingstall resigned, and Mr. Benezette Williams was appointed to fill the position. Mr. Williams submitted five routes for consideration, one of which, after slight modifications, was adopted. It is along this route that the channel is now being constructed.

General Description.

As will be seen from the accompanying map and profiles (Fig. 2), the route selected lies on the south and east side of the Desplaines River, and between the river and the old Illinois & Michigan Canal. It crosses the bends of the river in a few places, and here the river channel is to be diverted by the excavation of a new channel, as shown. The work, therefore, consists of the excavation of a main drainage channel to receive and carry west the waters of the Chicago River and Lake Michigan, and a river diversion channel to carry separately from the drainage channel the waters from the Desplaines River watershed. The construction of each of these channels involves various subsidiary works, which, while integral parts of the channels, are yet in a certain sense separate works. The principal of these are, first, the spillway at the head of the river diversion channel, which allows all water in excess of 300,000 cu. ft. per minute, coming down the Desplaines River, to flow east toward Chicago until the arrangements for carrying the entire floodwaters of this stream through Joliet are perfected; second, the controlling works at the west end of the channel to control the discharge of the water into the tailrace which is to deliver the outflow to the lower Desplaines River at Lockport; and, third, the water supply channel to deliver the necessary water from Lake Michigan to the main drainage channel.

The main drainage channel extends from the west fork of the South Branch of the Chicago River at Robey St., in the city of Chicago, to near Lockport, Will Co., Illinois, and is divided into 29 contract sections, each about one mile long. Beginning at Willow Springs, these sections are numbered from 1 to 15, going west, and from A to O, omitting J, going east. The dimensions of the canal sections vary according to the material penetrated. These different sections are shown in Fig. 3. The cross section of the earth sections from A to E, inclusive, and for about 500 ft. of section F, is 202 ft. on the bottom, with side slopes of 2 to 1. For the remainder of Section F, and for Sections G to O, inclusive, the channel is 110 ft. wide on the bottom, with side slopes of 2 to 1. The low water depth of the channel is 22 ft. throughout.

The reason for this change of section is as follows: Throughout the rock sections and in those sections in which there is a preponderance of hard material, the section is designed for a flow of 600,000 cu. ft. of water per minute, which means provision for a population of 3,000,000 people; while in the soft earth sections, where dredges can work, the section is designed for a flow of only 300,000 cu. ft. per minute, or provision for about the present population, it being intended to enlarge to the greater section when the increase in population demands it. The grade throughout the lettered sections is 0.0025%, or 1 ft. in 40,000 ft., and the bottom of the channel at Robey St. is 24.448 ft. below datum. Sections 1 to 6, inclusive, are in earth and rock, the rock underlying the earth all along this portion of the channel. Here a prism 160 ft. wide will be taken out of the bed rock and side walls will be built to a height of 5 ft. above datum. Sections 7 to 13, inclusive, are entirely in solid rock 160 ft. wide at the bottom and 162 ft. wide at the top. The grade in the rock sections is 0.005%, or 1 ft. in 20,000 ft. The plans for the sections beyond 13 involve the construction of controlling works and will be described in a separate article on these works.

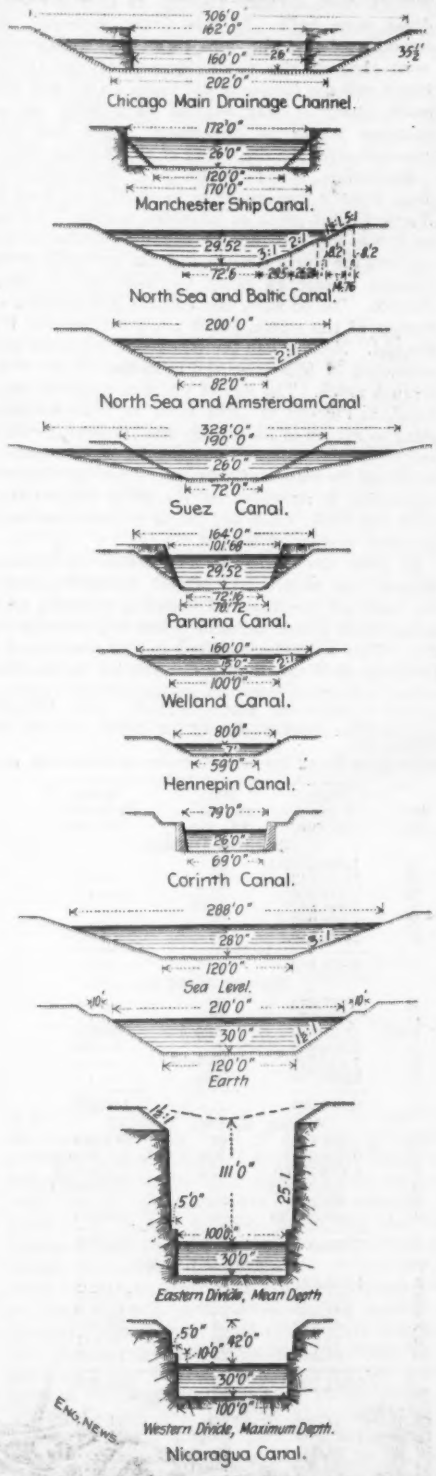


Fig. 4. Cross-Sections of the Great Canals of the World.

The river diversion channel is 200 ft. wide on the bottom, and has side slopes of 1½ to 1, and a grade of generally 0.012%, or about 1 ft. in 8,335 ft. Further details of the main drainage and river diversion channels and their relative location in respect to the Desplaines River, the Illinois & Michigan Canal and the various railway lines are shown by the map. The profiles show the depth of excavation at different points and the relative amounts of earth and rock excavation.

For the purpose of letting the contracts the material to be excavated was divided into two classes, rock and "glacial drift." The first term explains itself, but the character of the material termed "glacial drift," this being an entirely arbitrary classification, needs some further explanation. As defined in the specifications, "glacial drift shall comprise the top soil, earth, muck, sand, gravel, clay, hardpan, boulders, fragmentary rock displaced from its original bed, and any other material that overlies bed rock." In fact, all these materials are found in all degrees of intermixture, from soft black muck, which can be pumped with centrifugal pumps, to a conglomerate of sand, gravel, clay, and boulders cemented together with almost the hardness of rock, and only to be excavated by means of the strongest steam shovels, and sometimes even requiring blasting to break it up. The exact character of the material on each contract section will be more exactly set forth in following articles describing the methods of excavation adopted by the different contractors.

The entire 29 sections are now under contract. Sections 1 to 14, inclusive, were put under contract in July, 1892; sections A to F, inclusive, late in 1892 and early in 1893; sections I to M, inclusive, in December, 1893, and sections N and O in May and June, 1894. On a considerable number of sections the original contractors have given way to new firms of contractors either through the forfeiture and reletting of their contract or its transfer by sale, and these changes will be noted as far as seems needful in following articles. In this article the names of the present contracts, only, are given in the accompanying table. (Table 1.)

The significance of these totals of earth and rock to be excavated is not easily realized, even by engineers. Compared with the excavation required in other great canals, these figures given in round numbers stand as follows:

	Tot. excav., cu. yds.
*Panama Canal	200,000,000
Suez Canal	98,000,000
*Nicaragua Canal	70,000,000
North Sea and Baltic Canal	67,000,000
Manchester Ship Canal	48,000,000
Chicago Main Drainage Channel	40,000,000
Corinth Ship Canal	11,000,000

* Not yet constructed.

The cross section of the Chicago Drainage Channel compared with the characteristic cross sections of these and other well-known canals is shown in Fig. 4.

The officers to whom the task of carrying out this great work has been entrusted by the citizens of Chicago consist of a Board of nine Trustees, a Treasurer, Clerk, Attorney, and Chief Engineer. The present incumbents are: Board of Trustees, Messrs. Frank Wenter, President; John J. Altpeter, William Boldenweck, Lyman E. Cooley, A. P. Gilmore, Bernard A. Eckhart, Thomas Kelly, Richard Prendergast, William H. Russell; Treasurer, Mr. Melville E. Stone; Clerk, Mr. Thomas F. Judge; Attorney, Mr. Geo. E. Dawson; Chief Engineer, Mr. Isham Randolph. Mr. Thos. T. Johnston is First Assistant Chief Engineer, and Mr. Uri W. Weston is Superintendent of Construction.

A trolley mail service has been started in Boston, and it has, so far, given much satisfaction in the regularity and speed of its working. A specially constructed mail-car is used.

THE INTERNATIONAL STREET-SWEEPING MACHINE.

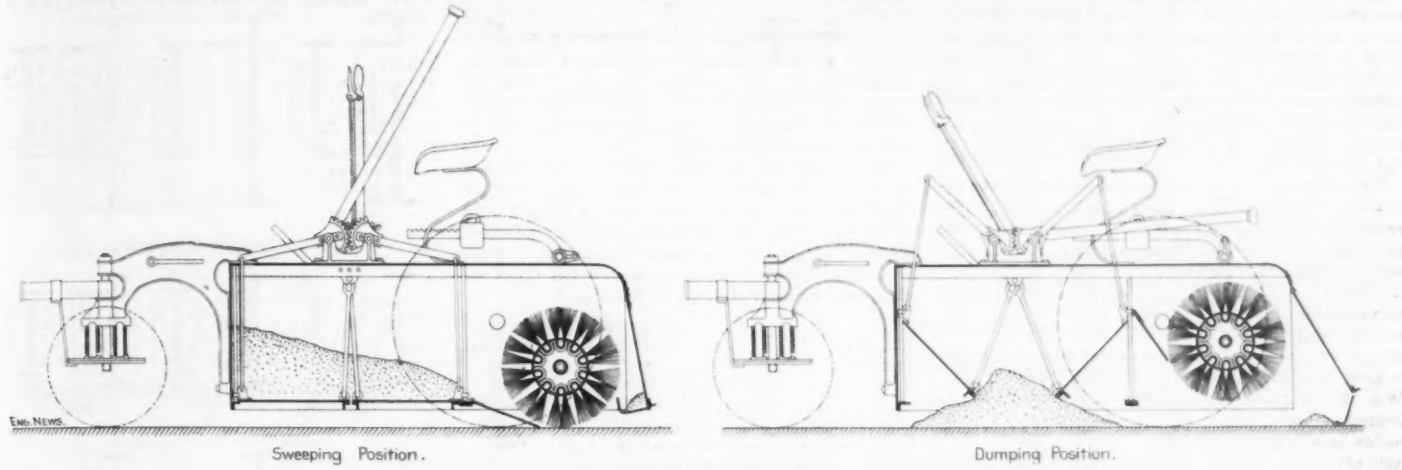
If street cleaning is to be done economically there is little doubt that machinery must be used to the greatest possible extent; but in order to combine efficiency with economy it is necessary to have a good machine and a good street surface, for no sweeping machine can do good work on a pavement full of ruts and holes. On such a surface hand work alone can be relied upon to give good results. Street-sweeping machines which brush the dirt into windrows at the sides of the street have been used for many years, but these require a separate system of hand sweepers to brush the dirt into piles ready for shoveling into the carts, and many inventors have worked on the problem of designing a machine which will collect the dirt as it goes along and deposit it in piles, instead of merely sweeping it into windrows. The difficulties in collecting and regularly dumping the miscellaneous mass which the sweeping broom gathers up, however, are very great. A favorite idea of inventors has been to place the bin for the sweepings on top of the machine; but how to elevate them to that point by any mechanical means, without sending a cloud of dust about or clogging the machine with mud, sticks, rags, etc., is a problem which has generally been given up as too difficult.

We illustrate herewith a street-sweeping machine which has recently been placed on the market, in which the collecting bin is set so low that the revolving broom sweeps the dirt directly into it, the operation being much like that of an ordinary carpet sweeper. The machine consists of an iron box with hinged sides and bottom, and open at the back to receive the dirt brushed up by the revolving broom, the dirt being forced up the loose hinged plate extending from the back of the box to the pavement. The broom is entirely enclosed, and the back part of the casing forms a receptacle for dirt carried over by the brush and which would otherwise be deposited upon the swept surface. The box has a capacity of 1 cu. yd., but it cannot, of course, be filled to its capacity, as the dirt would fall back upon the broom, and, in fact, the dirt has a tendency to form a ridge near the open end of the box, which prevents the entrance of fresh dirt carried up by the broom, so that the box has to be dumped frequently in order to prevent the dirt from dropping back on the street. In order to dump the sweepings, the long lever on top is thrown back, thus raising the bottom at the front and back and separating the bottom at the middle. At the same time the dirt in the back casing is dumped and the broom is raised so that the machine can be hauled across the pile of dirt.

It will be evident that this dumping leaves the dirt somewhat scattered and spread out; but the dumping is nevertheless said to be more satisfactory than that of any other dirt-collecting sweeper thus far tried. In operating the machine, an intelligent driver is needed, who will be careful to observe when the bin is full and it is time to dump, and who will zigzag his team from side to side when picking up a windrow, and thus collect the dirt evenly in the box, instead of heaping it in the center. Three of these machines have recently been tried in New York with good results as regards economy, and with fair results as regards efficiency when carefully and intelligently handled as just noted, especially when used for sweeping up the windrows left by the ordinary side sweepers.

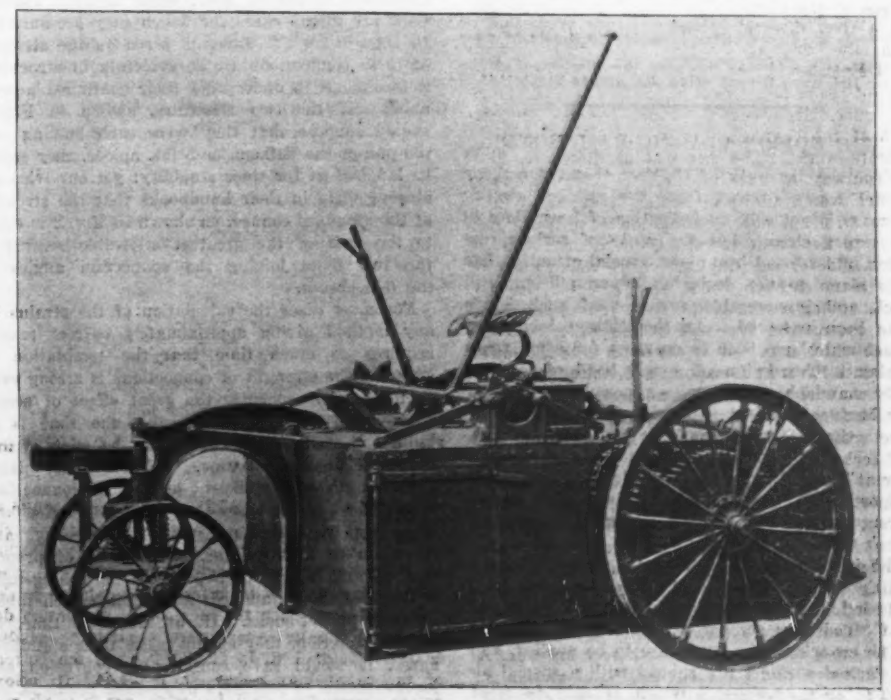
The machine is made of iron and steel, is mounted on four wheels and is drawn by two horses. The broom is 5 ft. long and revolves on a stationary spindle running through a tube in the center of the broom. The bearings are of babbit metal or brass run into the ends of the tube for a distance of 4 ins., the space between the bearings being used as a dustproof oil chamber, which does not require replenishing during the life of the broom. Medium coarse bass is used for the broom and the life is from 18 to 25 days. The broom-shaft is driven by a sprocket chain and gearing, as shown. The machine weighs about 2,500 lbs., sweeps within a foot of the curb, and the driver can regulate the pressure of the broom on the pavement or throw it out of gear. It can be used for piling the dirt swept to the side of the street by an ordinary side-sweeping machine, and has thus been used by Fuehring Bros., street cleaning contractors, of Indianapolis, Ind., who prefer to use three horses when using it in this way, so as to haul it faster between dumps and keep up with the side sweepers. In this way they save the cost of three gutter men and half the teams for hauling off the sweepings, as the wagons can be loaded so much more quickly on account of the piling of the dirt.

The machine is manufactured by the International Sweeping Machine Co., of Dayton, O., to whom we are indebted for photographs and blueprints from which our illustrations are prepared.



Sweeping Position. Dumping Position.

SECTIONAL ELEVATIONS OF INTERNATIONAL STREET SWEEPING MACHINE.



VIEW OF INTERNATIONAL STREET SWEEPING MACHINE.

THE EXAMINATION PAPERS FOR THE POSITION OF CHIEF OF THE PHILADELPHIA WATER BUREAU.

The following lists of questions were submitted on May 11 to the applicants for the position of Chief of the Water Bureau of Philadelphia. The two examinations were held in the morning and in the afternoon of the same day. When the salary and the importance of the office are considered, the questions are certainly not too difficult, and they appear to be admirably designed to bring out the relative fitness of the candidates. It will be noted that they are so framed as to test pretty thoroughly the extent to which the applicant has kept himself posted as to modern methods and general progress in hydraulic engineering. As we understand the present case, Philadelphia is especially in need of this advanced practice in the man-

agement of her Water Bureau, and the board of examiners evidently had this need in mind in framing the questions submitted:

Morning Examination—9 a. m. to 1 p. m.

1. Give the different systems of water supply.
2. Sketch some of the different types of boilers and state briefly their relative points of merit.
3. What should be the economical evaporation of 1 lb. of coal in the best type of boilers?
(b) What should be the ratio of grate to heating surface?
(c) What should be the ratio of heating surface to horse-power?
4. What data is required to test a boiler?
(b) What data is required to test an engine?
5. State the advantages and disadvantages of hand and automatic machine firing.
(b) State the advantages and disadvantages of natural and forced (mechanical) draft.
6. What should be the temperature of the escaping gases from a boiler?
(b) What should be the chemical analysis of the escaping gases?
7. State the different types of pumping engines.
8. What is meant by the duty of a pumping engine, and how is it ascertained?
9. What form or number of reciprocating pumps produces the steadiest flow?
10. Given 10,000,000 gallons of water to pump in 24 hours against 200 ft. head with boiler pressure 125 lbs. Ascertain:
(a) The economical diameters of the high and low-pressure cylinders.
(b) The diameters and thickness of metal in pumps.
(c) The diameter of steam and exhaust pipes.
11. Indicate by sketch the position of all valves from foot valve on suction pipe to end of discharge pipe.
12. Describe or sketch, say, three (3) of the standard water meters in the market.
13. Give the amount of water used per capita in Philadelphia, New York, Boston, London, Paris, in any one year from 1890-1894.
14. Sketch an ideal indicator card from a compound condensing engine, and explain the same.
15. Calculate the horse-power of a 24 × 48-in. engine running 70 revolutions, average pressure in cylinder 40 lbs.
16. How are cast iron pipes usually joined together?
17. What form of joints are applicable in cement pipes with iron pipe imbedded? Make sketch.
18. What form of valve is best suited for large pipe mains?
19. What form of valve is best for fire plugs?

Afternoon Examination—2 p. m. to 5 p. m.

1. Write a brief specification for testing Rosendale cement.
2. Explain three methods of testing brick.
3. Compare the relative strengths of two beams of the same material and span, the first being 2 × 4 ins., and the second 3 × 3 ins. in section.
4. State average weight and tensile strength of cast iron and of structural steel.
5. State facts regarding rainfall and evaporation in Pennsylvania.
6. Give a cross-section, with dimensions, showing method of construction of an embankment for a reservoir, the water to be 18 ft. deep.
7. What is the electrical method of purifying water?
8. Give a sketch, with dimensions, showing a vertical section of a filter bed; state changes which impure water undergoes in passing through a filter bed.
9. State methods and results of filtration at Antwerp, Belgium; at Poughkeepsie, N. Y.; at Lawrence, Mass.; and at two other U. S. cities.
10. Write the most important formula of hydraulics, explaining the meaning of each letter, and illustrating it by a numerical example.
11. Which will carry the more water, one 8-in. pipe or two 6-in. pipes?
12. What is meant by the hydraulic grade line, or hydraulic gradient? Give a sketch to illustrate your answer.
13. How would you measure the discharge of the upper Delaware River? Give sketches to illustrate?

THE EDISON PLASTIC RAIL BOND.

Since the discovery of the fact that the leakage of the return current from the rails of electric railways is not only an indication of heavy loss in the return circuit, but the cause of serious corrosion of lead and iron pipes, special attention has been given to the designing of an efficient rail bond, and innumerable varieties of such bonds have been patented. At the Edison laboratory experiments have been in progress for some years looking to the design of a rail bond of low resistance, which would make a permanent contact and be proof against rust and mechanical injury due to the motion of the rails, variations of current, changes of temperature, etc. As a result a "plastic" rail bond has been devised, which is said to show remarkably small drop when carrying a current of 1,500 amperes after about four years' service. It consists of a disk of plastic metal or alloy placed between the web of the rail and the splice bars, two of the disks being used at each joint. The surfaces of rail and splice bar are cleaned by a scraper or small emery wheel at the places where the bonds are to be applied, and the cleaned surfaces are rubbed with a special alloy or "iron amalgam," which is said to repel water and prevent corrosion. Upon the treated part of each rail is then placed a flat ring of molded cork 3⅞ ins. diameter outside and 1½ ins. inside, and ⅝ in. thick, the cork being covered with a viscous insulating compound which will adhere to the steel when slightly heated. When each ring is firmly fixed in place, a plug of the plastic metal, surrounded by a steel spring, is inserted in the hole (the sides of the hole sloping downward toward the rail), and the splice bar is then bolted on, compressing the cork ring and the metal composition so as to insure a thorough contact. The composition will remain plastic indefinitely, and is unaffected by any leakage of water, acid, etc., while the elasticity of the cork allows for changes in rails and splice bars due to the changes of temperature.

For connections to cross bonds or feed wires a third bond is placed on the rail near the end of the splice bar, and clamped upon a tinned strip of sheet copper, to which the wire is soldered. Tests of a "plastic" bond and a ⅝-in. copper bond, with the best mechanical contact of ten times its cross-section, showed drops as follows:

Current, amperes.	Drop with plastic bond, volts.	Drop with copper bond, volts.
100	0.005	0.08
500	0.0225	0.315
1,000	0.0475	0.455
1,500	0.07	0.515

STANDARD CONNECTIONS FOR ROLLED BEAMS.

By Henry S. Prichard, M. Am. Soc. C. E.

The method of proportioning the connections for rolled beams which is commonly used by architects and engineers nearly always errs on the side of weakness. The error consists in assuming as the strength of a connection an amount equal to the greatest allowable strain on one bolt multiplied by the number of bolts joining the connection angles to the beam, thus entirely neglecting the effect which the unavoidable eccentricity has on the amount and direction of the strains in the bolts. Even by those who realize the fact that eccentricity increases the strains, it is commonly supposed that this increase is too small to be of practical importance. Such a conclusion, however, is at variance with the results of calculations which take the eccentricity into account.

The general failure to give this question of eccentricity the careful attention it requires has resulted in the adoption of standard connections which have not sufficient strength to support heavily-loaded beams of short span without limiting their use to the cases for which they are suitable. In some cases the amounts given as the strength of these connections are so evidently in error that it is difficult to understand their continued acceptance. If the two Brownies, shown in Fig. 1 should suppose that they were each holding half the pull of the balloon, or 5 lbs. apiece, they would be laughed at for their stupidity; yet our wise engineers state in their handbooks that the strength of the standard connection shown in Fig. 2 is equal to the sum of the greatest allowable strains in the two bolts joining the connection angles to the 6-in. beam.

For most cases the calculation of the strains by any method giving approximately correct results requires so much time that the temptation to guess at the strength of connections is strong even to those who recognize the great effect of eccentricity. In fact, in many cases the time is so limited that no other course can be adopted and the work finished on time. Reliable tables giving the strength of a sufficient number of connections to suit most of the cases that arise in practice will do away with this necessity for guessing, and do much to improve current methods of proportioning, and it is to be hoped that the rolling mills will revise their standards and publish such tables in their pocket-books. If, at the same time, by concerted action, they should make their standards agree, it would save considerable confusion and inconvenience to engineers using their products.

In the accompanying tables, which are in use in the office of the New Jersey Steel & Iron Co., the effect of eccentricity has been taken into account. The strength of the connections is based on an allowable shearing strain of 7,500 lbs. per sq. in., and a bearing strain of 18,000 lbs. per sq. in. It was assumed in making the calculation that the end reactions were wholly vertical and acted at the

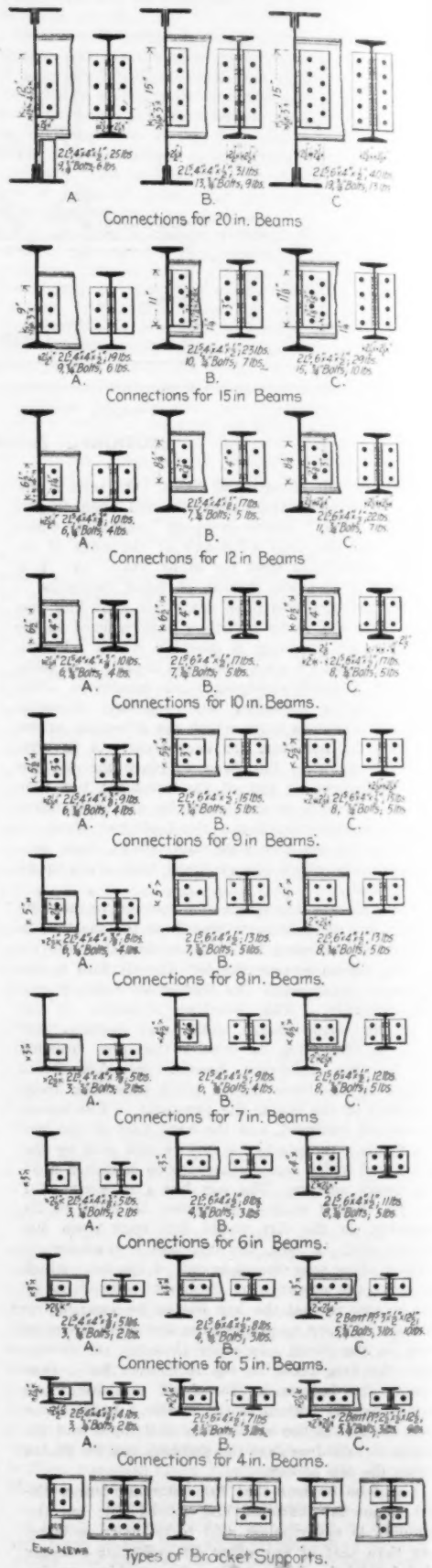

A
B.
C
Connections for 20 in. Beams
Connections for 15 in Beams
Connections for 12 in Beams
Connections for 10 in. Beams.
Connections for 9 in Beams.
Connections for 8 in. Beams.
Connections for 7 in. Beams
Connections for 6 in Beams.
Connections for 5 in. Beams.
Connections for 4 in. Beams.
Types of Bracket Supports.

Fig. 4. New Jersey Steel & Iron Co.'s Standard Connections for I Beams.

extreme ends of the beams—that is, at the back of the connection angles, and the effect of friction was neglected.

The method of calculation is as follows: Let n = the number of bolts connecting the angles to the end of the beam; let p = the safe load on the connection; let a be such a quantity that na = p; let x_1, x_2, x_3, etc. = the strains on the bolts, and b = the distance from back of angle to the center of gravity of forces a.

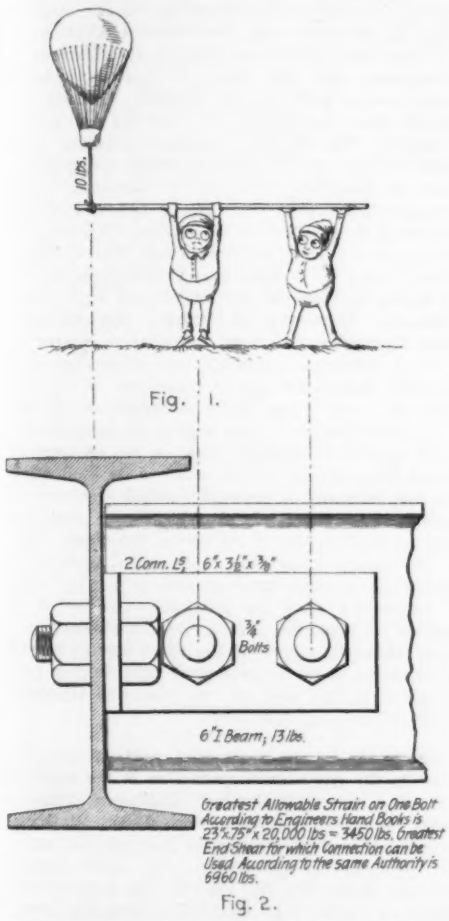

10 lbs.
2 Conn. L's 6"x 3½"x ⅜"
⅞" Bolts
6" I Beam, 13 lbs.
Greatest Allowable Strain on One Bolt According to Engineers Hand Books is 23"x.75"x 20,000 lbs = 3450 lbs. Greatest End Shear for which Connection can be Used According to the same Authority is 6960 lbs.

Fig. 1.

Fig. 2.

Fig 2. Standard Connection for 6-in. I Beam.

The forces p, x_1, x_2, x_3, etc., must be in equilibrium. This fact is indicated in Fig. 3 by force and funicular polygons. To assist in making the calculation, each of the forces x_1, x_2, x_3, etc., is divided into two parts, as follows: x_1 is divided into a and y_1; x_2 into a and y_2; x_3, into a and y_3, etc. The sum of the forces p and na equals o, but they have a moment; that is, a tendency to rotate, of pb. The sum of the forces, y_1, y_2, y_3, etc., will therefore equal o, and their moment will equal pb.

The center of rotation of the forces y_1, y_2, y_3, etc., is assumed to be coincident with the center of gravity of the bolt areas. The correctness of this assumption has not been demonstrated, but it is believed to be substantially correct from the analogy of the position of the neutral axis assumed in determining the moment of inertia of any sectional area.

Let d_1, d_2, d_3, etc., equal the distances of the forces y_1, y_2, y_3, etc., from the center of rotation. The forces y_1, y_2, y_3, etc., will be to each other as their lever arms, d_1, d_2, d_3, etc., and the moments of each of the forces as the squares of d_1, d_2, d_3, etc. The moment of resistance will be,

$$y_1\left(\frac{d_1^2+d_2^2+d_3^2, \text{etc.}}{d_1}\right)=pb.$$

From this equation, d_1, d_2, d_3, etc., being known, the value of y can be obtained in terms of p. By combining y and a, n being known, the value of x_1 can be obtained in terms of p, and as the greatest allowable strain in x_1 is known, the greatest allowable value for p can be obtained.

TABLE GIVING THE END REACTIONS FROM QUIESCENT LOADS FOR WHICH THE NEW JERSEY STEEL & IRON CO.'S STANDARD BEAM CONNECTIONS ARE DESIGNED AND THE LENGTHS OF THE SPANS WHICH WILL BRING THESE REACTIONS WHEN THE BEAMS ARE UNIFORMLY LOADED WITH THEIR MAXIMUM SAFE LOADS.

Size of beams.		Connection A. ¾-in. bolts.		Connection A. ⅞-in. bolts.		Connection B. ¾-in. bolts.		Connection B. ⅞-in. bolts.		Connection C. ¾-in. bolts.		Connection C. ⅞-in. bolts.	
Depth, ins	Lbs. per yd.	End react'n, lbs.	Span, ft.	End react'n, lbs.	Span, ft.	End react'n, lbs.	Span, ft.	End react'n, lbs.	Span, ft.	End react'n, lbs.	Span, ft.	End react'n, lbs.	Span, ft.
IRON BEAMS.													
20	272	18,470	35.73	25,170	26.22	30,550	21.00	41,630	15.85	39,720	16.61	54,120	.....
20	200	15,710	31.50	18,310	27.04	25,990	19.05	30,280	.....	33,780	.....	39,360	.....
15	200	14,990	24.95	17,830	20.97	21,470	17.42	25,540	14.64	26,480	14.12	31,500	.....
15	150	12,750	21.61	14,850	18.55	18,260	15.08	21,280	12.94	22,520	12.23	26,240	.....
15	125	10,700	21.49	12,480	18.12	15,320	15.00	17,880	12.84	18,900	12.18	22,050	.....
12¼	170	9,930	25.73	11,810	21.63	14,440	17.69	17,180	14.87	16,210	15.76	19,290	13.25
12¼	125	7,930	23.76	9,254	20.37	11,540	16.34	13,460	14.00	12,950	14.56	15,110	12.48
10½	135	7,930	22.69	9,254	19.45	9,000	19.86	10,580	17.02	11,970	15.04	13,970	12.89
10½	105	6,330	22.59	7,380	19.38	7,230	19.77	8,430	16.95	9,560	14.97	11,140	12.84
10½	90	5,280	23.67	6,150	20.33	6,030	20.72	7,030	17.78	7,970	15.69	9,280	13.47
9	125	7,900	16.89	9,260	14.48	9,870	13.58	11,510	11.64	12,620	10.62	14,720	9.10
9	85	5,220	19.06	6,090	16.35	6,490	15.33	7,570	13.15	8,300	11.99	9,680	10.28
9	70	4,180	20.00	4,870	17.14	5,190	16.08	6,060	13.79	6,640	12.59	7,750	10.78
8	80	4,520	18.58	5,270	15.94	6,180	13.60	7,200	11.67	7,560	11.11	8,810	9.53
8	65	3,620	18.67	4,220	16.00	4,940	13.66	5,760	11.71	6,050	11.17	7,050	9.57
7	55	.....	.....	.....	.....	3,320	15.21	3,870	13.04	5,870	8.69	6,850	7.37
6	120	.....	.....	.....	.....	4,410	19.49	5,470	15.73	11,030	7.79	.....	.....
6	90	.....	.....	.....	.....	3,750	17.58	4,370	15.09	9,380	7.03	.....	.....
6	50	.....	.....	.....	.....	2,250	17.33	2,630	14.86	5,630	6.93	.....	.....
6	40	.....	.....	.....	.....	1,870	16.71	2,190	14.31	4,680	6.68	.....	.....
5	40	.....	.....	.....	.....	2,350	10.46	2,730	8.98	3,440	7.15	4,000	6.14
5	30	.....	.....	.....	.....	1,870	10.33	2,190	8.85	2,740	7.06	3,200	6.05
4	37	.....	.....	.....	.....	2,350	7.84	2,730	6.73	3,440	5.36	4,000	4.60
4	30	.....	.....	.....	.....	1,870	8.04	2,190	6.88	2,740	5.49	3,200	4.70
4	18	.....	.....	.....	.....	1,410	6.40	1,640	5.49	2,060	4.37	2,400	3.75
STEEL BEAMS.													
15	150	11,460	32.85	13,370	28.16	16,420	22.93	19,160	19.65	20,250	18.59	23,600	15.94
15	125	10,190	29.59	11,890	25.37	14,600	20.65	17,030	17.70	18,000	16.75	21,000	14.36
12	120	6,580	37.99	7,680	32.56	9,570	26.11	11,170	22.38	10,750	23.27	12,540	19.94
12	96	5,400	37.62	6,300	32.30	7,860	25.91	9,160	22.21	8,820	23.08	10,290	19.78
10	135	7,590	30.35	8,860	26.01	8,680	26.56	10,130	22.76	11,460	20.11	13,370	17.24
10	99	6,240	27.55	7,290	23.61	7,140	24.10	8,330	20.66	9,430	18.25	11,000	15.64
10	76½	5,400	24.44	6,300	20.95	6,170	21.39	7,200	18.33	8,150	16.19	9,510	13.88
9	81	4,310	30.37	5,030	26.02	5,370	24.42	6,260	20.93	6,860	19.09	8,010	16.36
9	63	3,760	26.61	4,390	22.80	4,670	21.40	5,450	18.34	5,980	16.74	6,970	14.34
8	66	3,250	29.50	3,800	25.29	4,450	21.60	5,190	18.51	5,440	17.65	6,350	15.12
8	54	3,010	25.57	3,510	21.91	4,110	18.72	4,800	16.04	5,030	15.29	5,880	13.11
7	60	.....	.....	.....	.....	2,990	25.28	3,490	21.66	5,280	14.29	6,160	12.25
7	46½	.....	.....	.....	.....	2,550	23.18	2,970	19.86	4,500	13.11	5,250	11.24
6	50	.....	.....	.....	.....	2,250	23.11	2,630	19.81	5,630	9.24	.....	.....
6	40	.....	.....	.....	.....	1,870	22.24	2,190	19.05	4,680	8.89	.....	.....
5	39	.....	.....	.....	.....	1,950	17.18	2,280	14.73	2,850	11.74	3,330	10.07
5	30	.....	.....	.....	.....	1,650	16.03	1,920	13.75	2,420	10.95	2,820	9.39
4	30	.....	.....	.....	.....	1,800	11.44	2,100	9.81	2,630	7.82	3,070	6.70
4	22½	.....	.....	.....	.....	1,500	10.47	1,750	8.97	2,200	7.16	2,500	6.13
IRON BEAMS (STEEL PATTERN).													
15	150	11,460	24.64	13,370	21.12	16,420	17.20	19,160	14.74	20,250	13.94	23,630	.....
15	125	10,190	22.19	11,890	19.01	14,600	15.49	17,030	13.28	18,000	12.56	21,000	.....
12	120	6,580	28.49	7,680	24.42	9,570	19.59	11,170	16.79	10,750	17.45	12,540	14.95
12	96	5,400	28.33	6,300	24.29	7,860	19.48	9,160	16.69	8,820	17.35	10,290	14.87
10	135	7,590	22.76	8,860	19.51	8,680	19.92	10,130	17.07	11,460	15.08	13,370	12.93
10	99	6,240	20.66	7,290	17.71	7,140	18.08	8,330	15.49	9,430	13.69	11,000	11.73
10	76½	5,400	18.33	6,300	15.71	6,170	16.04	7,200	13.75	8,150	12.15	9,510	10.41
9	81	4,310	22.77	5,030	19.52	5,370	18.31	6,260	15.69	6,860	14.32	8,010	12.27
9	63	3,760	19.95	4,390	17.06	4,670	16.05	5,450	13.75	5,980	12.55	6,970	10.76
8	66	3,250	22.15	3,800	18.95	4,450	16.20	5,190	13.88	5,440	13.24	6,350	11.34
8	54	3,010	19.18	3,510	16.43	4,110	14.04	4,800	12.03	5,030	11.47	5,880	9.84
7	60	.....	.....	.....	.....	2,990	18.94	3,490	16.23	5,280	10.72	6,160	9.19
7	46½	.....	.....	.....	.....	2,550	17.39	2,970	14.90	4,500	9.83	5,250	8.43
6	50	.....	.....	.....	.....	2,250	17.33	2,630	14.86	5,630	6.93	.....	.....
6	40	.....	.....	.....	.....	1,870	16.71	2,190	14.31	4,680	6.67	.....	.....
5	39	.....	.....	.....	.....	1,950	12.89	2,280	11.05	2,850	8.81	3,330	7.55
5	30	.....	.....	.....	.....	1,650	10.33	1,920	8.85	2,420	8.20	2,820	7.04
4	30	.....	.....	.....	.....	1,800	8.58	2,100	7.36	2,630	5.87	3,070	5.03
4	22½	.....	.....	.....	.....	1,500	7.85	1,750	6.73	2,200	5.36	2,500	4.60

Note.—Connections A are intended mainly for beams which rest on supports proportioned for the entire reaction. The values given in the table are for cases where there are no supports other than the connections. In a number of cases the values given for the connections exceed the allowed shearing strain on the beams. In these cases the lengths of the spans have been omitted. If the angle clips are riveted to the beams in the shop, the safe end reactions will be 20% greater than given for bolts.

The standard connection shown in Fig. 2, which is given in handbooks as 6,060, and which, by the method there used, has an indicated value of 6,210 lbs., if we take the allowed bearing strain at 18,000 lbs. instead of 20,000 lbs. per sq. in., really

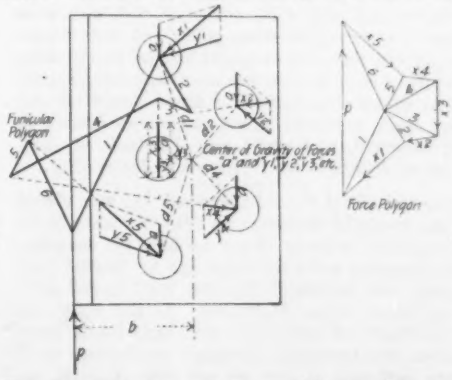


Fig. 3. Funicular and Force Polygons Showing that the Load on the Connection and Stresses in the Bolts are in Equilibrium.

has an indicated value 1,725 lbs. by the method just explained.

If the foregoing comparison was a fair indication of the weakness of the ordinary run of beam connections, it would indeed be alarming. Fortunately the two methods give results more nearly in accord as the beams increase in depth, and few beams require the strength in the connections which the common faulty method indicates that they have.

The influence of friction and of the torsional resistance of the cross-beams, which has been neglected, is on the side of safety, and may in some cases have saved beams from failure, but it should be remembered that friction cannot be relied on, and if the bolts are loose, may become almost nothing, and that the torsional resistance of the cross-beams may be quite small, especially if the connections are all on one side. While the example given cannot be regarded as a criterion of the weakness of the ordinary run of beam connections, it is applicable with nearly full force to occasional instances, and to a less, but still serious extent, to cases which are of frequent occurrence.

In view of the large and growing use made of steel beams, the importance of making connections which can be depended on to realize, at least approximately, the strength of the beams, cannot be doubted; yet the engineering and architectural professions still tolerate and even encourage the use of methods which a careful study cannot help but show to be faulty. It is probable that this acceptance of the ordinary rules is without thought or question on the part of engineers, and that if they gave the matter careful consideration they would insist on a sound practice. It is to be hoped that an interest will be stimulated which will result in the subject receiving the attention it needs.

ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

Published Weekly at Tribune Building, New York.
Entered at the Post Office, New York, as Second Class Matter.

VOL. XXXIII. THURSDAY, MAY 16, 1895.

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ADVERTISING RATES: 20 cents per line agate measure. Want notices, special rates, see page 22. Rates for standing advertisements sent on request. Changes of advertisements must be in hand on Monday afternoon: new advertisements, Tuesday afternoon; transient advertisements by Wednesday noon.

The great drainage canal which the city of Chicago is building to dilute the sewage-laden waters of the Chicago River and carry them west to the Mississippi River, far away from its source of water supply, is now under active construction for its entire length of 28 miles. In another column we have described briefly the causes and conditions which led to the beginning of this great work, and in a series of articles to follow during the next few months, we shall describe in considerable detail the methods adopted by the engineers and contractors in its planning and execution. The vast amount of earth and rock to be handled—in round numbers 40,000,000 cubic yards—and the low prices obtained for this work, have exercised the ingenuity and energy of both engineers and contractors to the utmost. As a prominent contractor recently expressed it, the problem has been largely how to "do much digging for little money." This, together with the policy of letting the work in short sections to many contractors, and the variableness of the material to be excavated, have operated to develop a great variety of different devices for accomplishing the work to be done. It is not too much to say that nowhere at any time in the history of the world have so many novel and different machines for excavating and removing earth and rock been in operation within so small a territory.

It should be, too, a matter of pride to American engineers that, with the experience of the Manchester, Baltic, Suez and other great canal works before them, none of the characteristic English, German and French methods of work were adopted here. With practially no experience in canal excavation on so great a scale, both engineers and contractors have evolved methods and apparatus for carrying on such work which will challenge the competition of the whole world for efficiency and economy. The importance of this fact is more far-reaching than the present work. It is only a matter of time when the proposed canal across the Isthmus of Nicaragua will be begun, let us hope by American capital and under American control, and then it will be to American engineers and contractors that we must look for successfully accomplishing the work. The surety that they can be depended upon to do it expeditiously and economically, which the experience of the Chicago Drainage Canal has afforded, cannot but help to aid in securing the faith of capitalists and the Federal Government in the feasibility and success of the great interoceanic canal.

In conclusion, it is but due to the men who have given their time and energies to the promotion of this important work for Chicago's sanitary welfare to mention somewhat more particularly than is appropriate in a descriptive article, those most prominent in the movement. The idea of a waterway across the Chicago Divide is a hundred years older than American Independence, and the suggestion for a drainage channel to carry Chicago's sewage to the Mississippi River dates back to the infancy of that city. Louis Joliet, the French explorer, advocated the one in 1674, and in 1855 Mr. E. S. Chesbrough foresaw the necessity of the other. Neither of these men, it is almost needless to say, ever contemplated a work of the magnitude and importance of the one now under way. The project which was but an idea with them, has been pushed to a reality within the last decade largely through the efforts of a few public-spirited men, among whom Mr. Lyman E. Cooley stands foremost in his persistent advocacy and energetic execution of the undertaking. It is not our purpose to enlarge upon the work of Mr. Cooley and his co-laborers here, but any description of the great canal which fails to note it, fails to note one of the forces which has made one of the greatest and most needed sanitary engineering works in the world an actuality.

Engineers in all branches of the profession will receive with sorrow the news of the sudden death of Eckley B. Coxe, which occurred on May 13. Mr. Coxe was an honored member of the principal engineering societies, and his activities as a member and officer, with his work as an author, had made him widely known among engineers both here and abroad.

The record of his life, which we have briefly reviewed in our personal column, is a record of honest achievement and faithful work. Inheriting a vast fortune, Mr. Coxe might have devoted his life solely to the pursuit of pleasure. Instead he chose to devote himself to professional work, with as much earnestness and zeal as if he had been dependent on his own exertions for a livelihood. His genial nature and unassuming personality have won him friends without number, and engineers everywhere who knew and loved him will feel a deep sense of personal loss at the news of his death.

If Jersey City wants to purchase a new water supply it must now ask bids for the fourth time within some three years. The Finance Board has non-concurred in the award of a contract to the Jersey City Water Co., noted in our issue of May 2, and has put itself on record in favor of new proposals under such terms as will permit of the widest competition. The vital question is, What are these terms? Only competent engineers and lawyers can say, and if the advice of such men were secured, their reports made public and their recommendations followed, as would be done in any other American city, we can see no reason why a good water supply at a reasonable figure should not follow. Such a course would inspire confidence in all concerned, and might save hundreds of thousands of dollars to the taxpayers of Jersey City.

The Otis Steel Co., of Cleveland, O., was placed in the hands of Receivers on May 9. As will be remembered by many of our readers, the company was organized some six years ago by English promoters, and purchased the Otis steel works at a round figure, about $4,500,000. In the report on the strength of which the stock and bonds were floated, the company's earnings were given at a figure sufficient to pay 10 per cent. interest on the capitalization. The profits of the works, however, since the English purchasers assumed control, have never been anything like the amount they were prior to the purchase. The falling off is said to be due partly to the depression in the iron and steel trade, and partly to the competition of other makers of boiler plate, which has been largely increased in recent years through the rapidly-growing practice of buying steel on engineers' specifications, instead of relying on the manufacturer's reputation for the quality of the product, as was the general practice a dozen years ago. It seems a little strange that the company should have weathered 1893 and 1894, to finally succumb at this time. It is given out, however, that the company is without funds to pay the interest soon falling due on its bonds, and for this reason the receivership has been established.

In referring to the late Act of Congress legalizing units of electrical measurements, in our issue of May 2, we stated that the National Academy of Sciences had not yet reported its specifications in accordance with this Act. In this we were in error, as we find that the National Academy did report about two months ago, and the Act is now complete. The following eminent scientists were appointed by the Academy to frame the specifications in question: Prof. H. A. Rowland, Johns Hopkins University; Gen. H. L. Abbot, Engineer Corps, U. S. A.; Prof. G. F. Barker, University of Pennsylvania; Prof. J. Trowbridge, Harvard University; Prof. C. S. Hastings, Yale University; Dr. C. Barus, Smithsonian Institution, and Prof. A. A. Michelson, University of Chicago. The specifications themselves are very technical in character, and all conditions, methods and dimensions are carefully defined for the determination of the ampere and volt. The National Academy of Sciences, including, as it does, among its members the most prominent scientific men of the country, is better than any other association of its kind fitted for the solution of scientific technical questions similar to the one lately placed before it, and this duty is, in fact, one of its special functions. But so far Congress has only twice called upon it to perform this duty, somewhat strange to say.; once in connection with the previous existence of a number of separate governmental geological surveys, when the advice of the Academy led to the organization of the present Geological Survey, and secondly, in the case of the electrical standard specifications here mentioned.

Among the events of the past week of most interest to the engineering profession is the publication of a new "Mechanical Engineers' Pocket-Book," by Wm. Kent., Am. Soc. M. E. We have reviewed this work on another page of this issue, but we make no apology for also calling attention to it here. We feel that we are quite within bounds in saying that whatever well-earned benefits the publisher and author may reap from the sale of this work, they will be trivial, indeed, compared with its value to the profession.

This value is due to the fact that up to the present time there has been no thoroughly good pocket reference book on mechanical engineering suited to the needs of American engineers. The best general reference book of this class has been D. K. Clark's invaluable "Rules, Tables and Data for Mechanical Engineers"; but this work is not in the convenient pocket-book form; it represents English engineering practice instead of American, and it was written many years ago. As for the principal American mechanical engineers' pocket-books, the opinion of engineers concerning them was well expressed by a prominent engineer recently in conversation with a member of the staff of this journal. Speaking of making estimates for a certain plant, he said: "I figured it out, using the quantities given in ——'s Pocket-book, which is practically the same thing as guessing."

Under these circumstances the appearance of a really reliable, complete and up-to-date American pocket-book for mechanical engineers is an event of great importance to the profession. The falling off in railway construction during the past few years has caused many hundreds of engineers whose early training and experience were almost wholly in civil engineering work, to turn to mechanical engineering. It is true also, that while specialization in the profession is growing, the classification of its members as civil engineers, mechanical engineers, mining engineers, electrical engineers, etc., seems destined to mean less in the future than it has in the past. The civil engineer

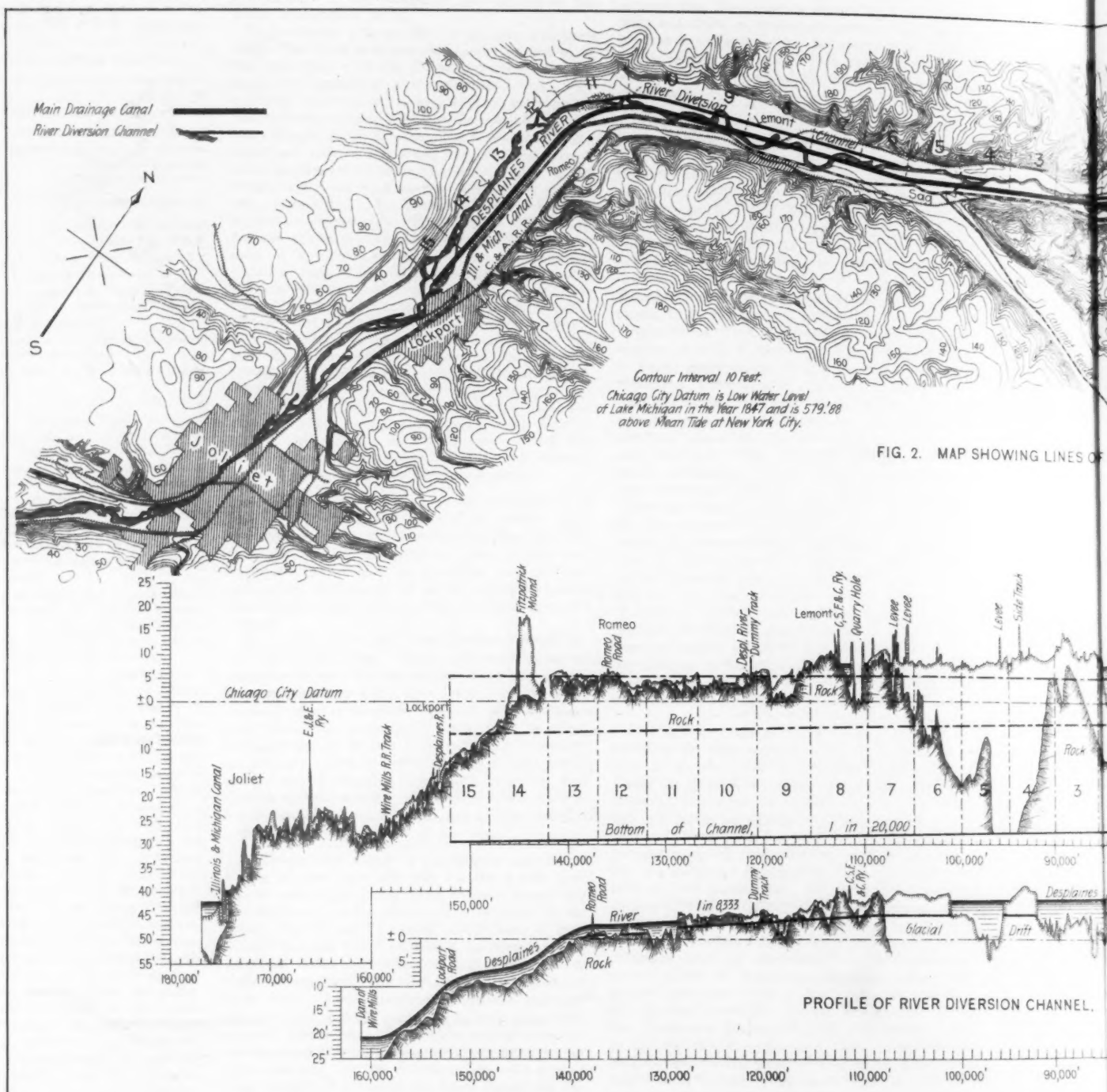
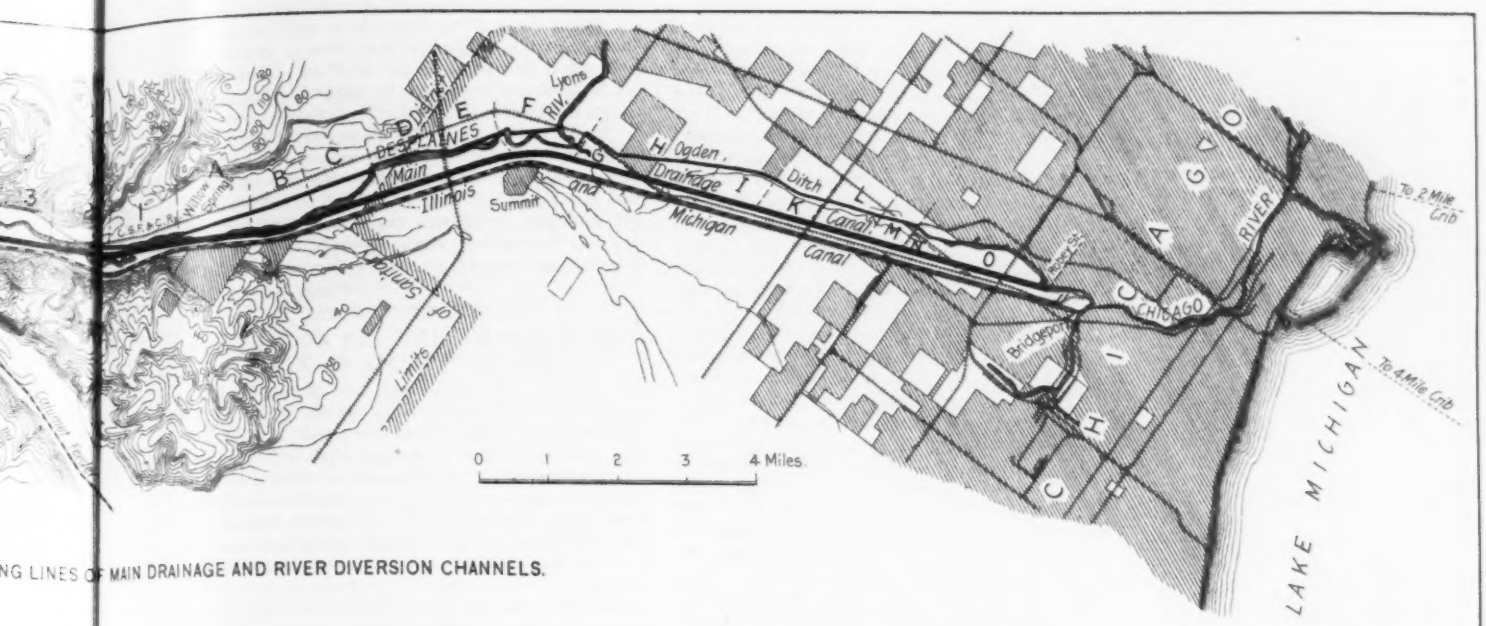


FIG. 2. MAP SHOWING LINES O

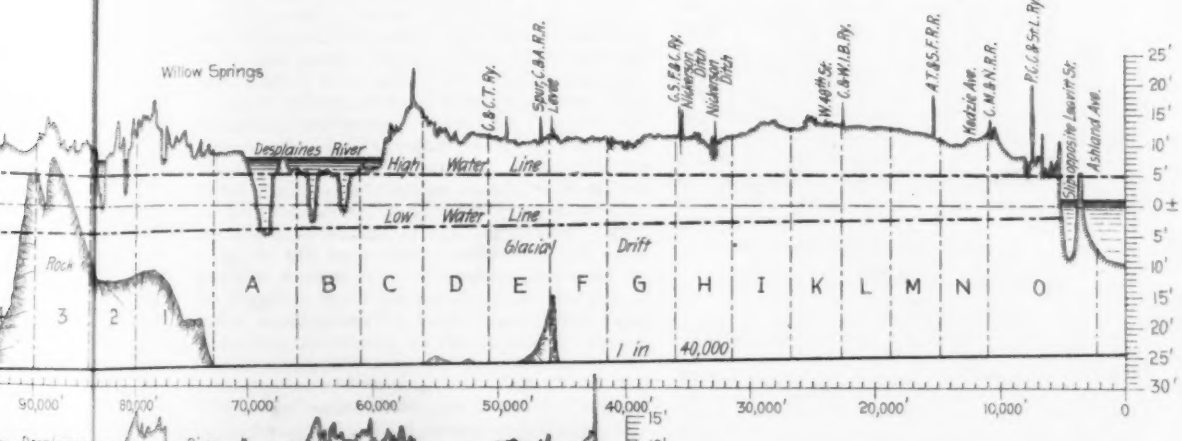
FIG. 3. CHARACTERISTIC CROSS-SECTIO

MAP, PROFILES AND CROSS-SECTIONS OF THE MAIN DRAINAGE CHANNE

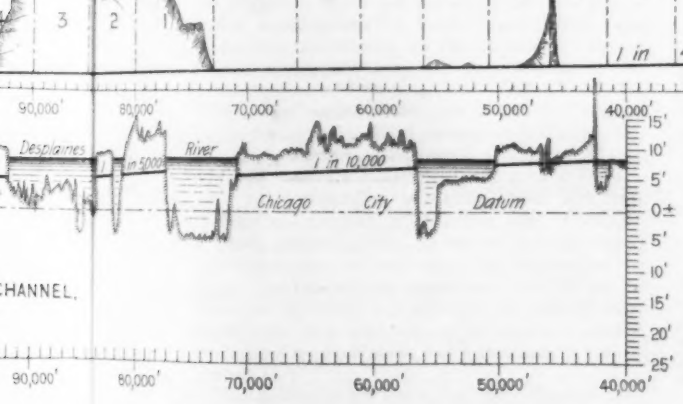
Isham Randolph, Chief Engineer;



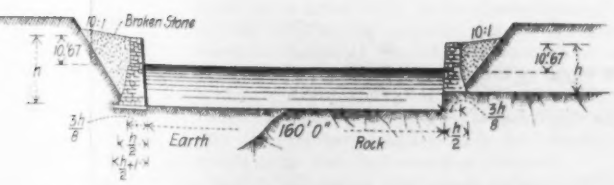
NG LINES OF MAIN DRAINAGE AND RIVER DIVERSION CHANNELS.

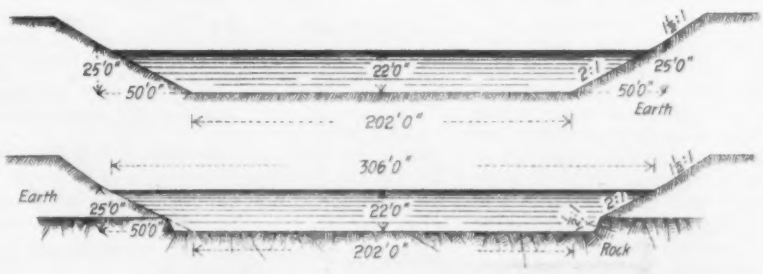


PROFILE OF MAIN CHANNEL.



CHANNEL.





Earth Sections.

OSS-SECTIONS OF THE CHICAGO MAIN DRAINAGE CHANNEL.

CHANNEL FOR THE SANITARY DISTRICT OF CHICAGO, FROM CHICAGO TO JOLIET.

Thos. T. Johnston, Assistant Chief Engineer.

CHAS. HART & SONS, LITH., 25 VESEY ST., N. Y.

who has not a pretty comprehensive knowledge of mechanical engineering, must find himself frequently badly handicapped in his work. The mechanical engineer who has not at least a good working knowledge of electrical work must supply the deficiency in some way or confess himself behind the times. In brief, for a broad and comprehensive study of many of the larger problems of engineering, some familiarity with each of its special branches is essential.

For these reasons we feel entirely safe in predicting that this new pocket-book for mechanical engineers will find a place beside Trautwine's, not only in the library of every mechanical engineer, but also in that of every other member of the profession who makes any pretensions whatever to the title of engineer.

A QUESTION FOR THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

More than a year ago, in our issue of Feb. 15, 1894, we published a description of an enterprise which was then prominently advertising its stock in reputable daily papers in New York city, but whose scheme, as shown by its circulars, which we reprinted verbatim in our columns, was so preposterous and absurd as to leave no doubt, in the mind of any intelligent engineer at least, as to the company's character. A correspondent, whose letter is published in another column, calls our attention to the fact that this concern is again advertising its stock for sale, and in a journal which has some circulation among engineers.

We do not apprehend that any further exposure of this scheme is needed in these columns to protect readers of this journal from being victimized by it, and except for one reason we should not have referred to it again. That reason, however, is one of serious interest to every engineer who values his professional reputation. In the advertisement in the "Contract News," to which our correspondent refers, we find a list of names of the "large stockholders" in the concern, and one of the men thus named is set down as a "Member of the American Society of Civil Engineers." Reference to our issue above referred to will show that this member was "Consulting Engineer" to the company, made the report on the strength of which subscriptions to stock were invited, and also poses, we believe, as the patentee of the invention which the company is organized to develop (?).

There are various ideas as to where a code of ethics for an engineering society should begin and end; but we take it that when a member of such a society uses his connection with it to give character to a fraudulent enterprise, it is high time to begin the application of such a code. Certainly, if a man promoting such an enterprise should apply for admittance to any reputable engineering society, the fate of his application would not be doubtful; and why any different rule should apply in the case of a man who, after joining a society, so misuses its good name and reputation, is not apparent.

This matter is not one to be lightly passed over. It is the opinion of those best qualified to judge that the elevation of the professional standard among engineers is most likely to be effected through the existing engineering societies. It is the aim of those in charge of the national societies of civil, mechanical and electrical engineers to make membership in them equivalent to a certificate of professional competency, and it is generally agreed that the standard requirements for membership should at no time be lowered or relaxed.

But it will be of little avail to draw the lines closely with respect to professional ability if they are to be in any way relaxed as regards professional integrity. The engineer occupies positions of trust and responsibility; positions where, from the very nature of the work, there can be no system of checks or supervision over him.

If, then, engineers as a body would make their position in the community secure, if they would secure the professional prestige and the ample compensation that their onerous work deserves, they will do well to cultivate and build up by every means possible the reputation of the profession for strict integrity.

Of course at the present time the profession at large has no control over its membership. Any one who chooses may call himself an engineer, no matter what his abilities or his character. A professional society, however, has the right to control its members, far enough, at least, to protect the reputation of the society, and it is its manifest duty to exercise such control.

Under the constitution of the American Society of Civil Engineers, ten corporate members can join in presenting charges against a member. The charges are heard by the Board of Direction, and the accused is given an opportunity to present his defence, after which action is taken. It is, perhaps, unfortunate that it is not made the duty of the Board to take this action of its own motion, but there should certainly be no difficulty in finding ten members willing to present charges in so flagrant a case as the one to which we refer.

If a member of the society were to be guilty of some gross crime, such as embezzlement, forgery or burglary, there would be no doubt as to what action should be taken. If a member were to steal from the society's treasury, his expulsion would be immediately demanded. But the injury done to the community at large by anything which injures public confidence in the engineering profession far transcends the injury committed by an ordinary felon; and the injury done to the good name of the American Society of Civil Engineers by the public use of its name in connection with a fraudulent enterprise far transcends any injury which could be done by stealing from its treasury.

And it should not be forgotten that this matter is of interest and importance to the members of other engineering societies. The action of the Civil Engineers in this case is bound to be a precedent which will be quoted and acted upon, if the need arises, in other societies. For this reason, as well as for the others we have enumerated, it is to be hoped that action may be taken in the matter without delay.

LETTERS TO THE EDITOR.

HOW TO CLEAN TRACINGS.

Sir: A year ago, Mr. F. S. Baille (now of the Gillette-Herzog Mfg. Co., of Minneapolis), told us of a method of cleaning tracings. We could not do without it now, and for the benefit of the readers of the News I ask you to publish this: Dampen a cloth (tracing cloth washed out) with benzine and apply to the tracing. It will remove blue, red or black pencil marks, or dirt, from the tracing.

Yours very respectfully, R. G. Manning.
The Toledo Bridge Company.

Toledo, Ohio, April 29, 1895.

EARTHWORK TABLES.

Sir: I desire to ask if you have ever published a system of tables "For use in making estimates of earthworks on preliminary surveys, having the center depth in cut or fill, and the transverse slopes taken by clinometer." These tables were by O. R. Young and Walter Bryant, civil engineers. Very truly yours,

L. H. Krebs.

144 S. 9th East St., Salt Lake City, Utah. May 4, 1895.

(We have never printed such tables, and shall be glad if any correspondent can give us the address of their publishers.—Ed.)

AN AIR-CUSHION FOR INCREASING SPEED OF STEAMERS.

Sir: With regard to the method of increasing the speed of ocean steamers by interposing between the water and the ship a stratum of air, as proposed by Mr. G. W. Pearsons, in Engineering News, of April 25, I would say that a Mr. Francis B. Stevens, of Hoboken, N. J., invented such a plan and patented it both in America and Europe, in 1847.

His plan provided the surface of contact of the vessel with shallow wedge-shaped recesses, the thin end of the wedge pointing backward. Each cavity was supplied with air through a small opening in the sheltered angle of the recess. The supply conduits (running fore and aft) communicated with an air compressor. A vessel was actually constructed carrying out this idea, which was found to be a failure in practice. Yours, Edgar J. Laschinger.

School of Practical Science, Toronto, May 3, 1895.

COMPARATIVE ECONOMY OF CEMENTS.

Sir: In the purchase of cement I have found it difficult to obtain the best cement at prices that would allow its use under the usual method of award to the lowest bidder of those offering cements that fulfilled the minimum requirements of the specifications. Such cement (lowest priced), even if of high grade, is not generally the most economical to use among those offered in cases where strong artificial stone or mortar is required. As a contribution to rules of practice governing awards of contracts for supplying cements, I have to suggest the following method of determining the most advantageous cement for important work when strength of sand mixtures as well as cheapness is a main factor. Take the lowest bid as representing the standard (100%) of "Cheapness." Divide this price by the other prices named in succession, which will give "relative cheapness" of the cements. Then take the highest tensile strength with 3 parts sand as the standard (100%) of strength, and divide the strength of each of the other samples by this maximum strength, which will give a table of "relative strength." Now, as the most economical cement is that which will give the strongest mortar at the least cost, and the economy is directly proportional to the cheapness—i. e., to the reciprocal of the cost—and also directly proportional to the strength of the mortar, or rather to the capacity of the cement to carry sand which is measured by its strength with large doses of sand, it is directly proportional to the product of these two ratios. The highest product of the two will indicate the most economical and advantageous cement to be used from among the cements tested, cheapness and strength only being considered—if the tests are made correctly. By this rule no account is taken of time of setting, fineness, or of the strength of neat briquettes, except indirectly as they affect the strength of sand mixtures. To illustrate, I send an abstract of recent proposals and tests, from which the award was decided in the manner described. I have omitted the names of bidders and brands. Very respectfully,

W. L. Marshall, Capt., Corps Engineers, U. S. A.

Chicago, Ill., May 8, 1895.

Comparative Economy of Eight Different Brands of German Portland Cements.

(Standard of comparison for economy is a cement that is as cheap as the cheapest giving mortar as strong as the strongest tested.)

Sample.	Tensile strength at 7 days, lbs. Neat.	3 sand, 1 cement.	Price per barrel	Relative cheapness.	Relative strength, 1 cem., 3 sand, mortar.	Relative economy, strength × cheapness.
1.....	472	157	$2.60	100.00	65.41	65.41
2.....	517	193	2.62	99.24	80.42	79.80
3.....	467	160	2.64	98.48	66.67	65.66
4.....	653	232	2.70	93.19	96.67	90.08
5.....	465	207	2.80	92.86	86.25	80.00
6.....	902	240	2.91	89.35	100.00	89.35
7.....	*	*	2.94	88.44	.....	.....
8.....	540	179	3.05	85.25	74.58	63.58

* No sample received.

THE INDESTRUCTIBLE PILE AND PIER CO. AGAIN.

Sir: Does not the enclosed advertisement, clipped from the "Contract News," of last week, refer to the company which was so thoroughly exposed in your issue of Feb. 15, 1894? W. W. C.

New York, April 27, 1895.

(It does. We supposed the company had retired from business long ago; but it appears to be truly "indestructible." There is one phase of this matter which seems to be of such importance to the profession, that we reprint the advertisement in full below, calling especial attention to the appearance of the name of the American Society of Civil Engineers, and have discussed it in our editorial columns. If any of our readers are not satisfied as to the character of the company by a perusal of its advertisement, we advise reference to our issue of Feb. 15, 1894.—Ed.)

Indestructible Pile and Pier Company.

In response to the numerous inquiries daily made from all parts of the country concerning this company, the officers take this method of laying before the public a full statement in regard to the company, its prospects and proposed plans.

The company is incorporated under the laws of the State of New Jersey.

Capital, $1,000,000, divided into 10,000 shares of $100 each. The stock is full-paid and non-assessable. Stockholders have no individual liability whatever.

The company owns all the rights, titles, interests in and the sole, absolute and exclusive right to manufacture and sell Indestructible Piles under United States patents.

Owing to the enormous demand for an indestructible pile in the construction of piers, jetties, docks, bulkheads, breakwaters, foundation for bridge piers, etc., applications are pouring in from engineers, contractors, and railway officials throughout the United States and Canada. The wooden piles heretofore used last

only from six months to a few years, requiring continual replacement at great expense. Our Indestructible Pile is permanent. There are 173,370 miles of railway in the United States, in which $10,941,711,122.00 are invested; 373 railway companies are now preparing to build 20,547 miles of new line. The great superiority of our pile in solid, substantial indestructible trestle work is causing the immense demand in this special field.

A portion of the stock is being sold at the low price of $20 per share in lots to suit purchasers. The price will be advanced shortly.

The company has no indebtedness of any kind. Estimated earnings will net the company $450,000 on a consumption of 50,000 piles per year—for the first two or three years—on which we are paid $10 per pile. Deduct $50,000 for advertising, office expenses, circulars, pamphlets, postage, etc. This pays 200 per cent. dividend per annum on stock costing only $20 per share, and enables the company to accumulate a handsome surplus besides.

It is proposed to increase the capital to $10,000,000, divided into 100,000 shares of $100 each, and give to the stockholders 10 shares for each share held by them, on which 4 per cent. dividends would be paid, equal to 200 per cent. dividends per year on their investment in the stock now at $20 per share.

The increased number of shares will give a larger and broader market for the stock when it is listed on the Stock Exchange.

Among the large stockholders are George D. Hilyard, esq., contractor, New York City; A. S. Service, esq., cashier First National Bank, Sharon, Pa.; Y. Carryer, esq., of the Canadian Pacific Railway Company, Field, B. C., Canada; Howard Swineford, esq., of Howard, Swineford & Co., Richmond, Va.; W. M. Shipp, esq., cashier of Deposit Bank, Midway, Ky.; Clarence Delafield, esq., member of the American Society of Civil Engineers; Hon. Thomas Murphy, ex-Collector of the Port of New York; R. A. B. Dayton, counsel of the company, 322 Broadway, New York, and other prominent capitalists, who will have seats in the Board of Directors, later on.

Investors can procure the stock at $20 per share in lots to suit by addressing the bankers and financial agents of the company, Messrs. Geo. W. Dunn & Co., 2 Wall Street, New York. Remit to them for the shares by check, draft, money order, or by express, or have the stock certificate sent by express C. O. D.

Attention is called to the fact that the Western Union, Edison Electric, Bell Telephone, Pullman Palace Car and many other companies commenced business with a small capitalization and sold stock at a low price. The original investors made enormous profits and hundreds of millions of capital are now profitably invested in these industries. The Indestructible Pile and Pier Company will have the same history.

SOLID FLOOR TRESTLE, ILLINOIS CENTRAL R. R.

Sir: I notice in your valuable paper of April 4 a description of a solid floor trestle bridge used on the Houston & Texas Central R. R.; and, for the information of your readers, I send you herewith a plan of the standard solid floor trestle used on the Illinois Central and Yazoo & Mississippi Valley railways. The material used in the construction of this trestle is entirely black and red cypress; and we use a large number of bridges of this class in swampy and low country on our Southern lines, their life being estimated at 12 years, without the use of creosote or other preservative treatment. The main advantages of this bridge are:

(1) Safety against fire.

(2) Low expense of maintenance, as practically no repairs are necessary, all inequalities of line and surface being taken care of by the ordinary section force, in the same manner as on any other section of track, thus doing away with the ordinary cost of bridge repairs.

(3) These bridges give as good and easy riding a track as any portion of the solid roadbed, and the average passenger, not realizing that he is passing over a bridge, does not experience the feeling of insecurity frequently felt in passing over long trestles.

(4) In case of derailment, there is less liability of damage to bridge, and accidents due to this cause are therefore less serious in their nature.

The first cost of these bridges approximates $1 per lin. ft. more than the ordinary trestle bridge, and, at present prices of material and labor, averages about $6 per lin. ft. of trestle. On the Louisiana Division, where a large number of these bridges have been built, and the workmen are expert in their construction, the cost of labor, exclusive of material, has been reduced to 40 cts. per lin. ft. of trestle for the bridgework alone, after the piles have been driven. This is due to the fact that no expert labor is necessary, as in the framing of the ordinary open trestle, and there is little work but what can be done with an ordinary saw and bridge augers, the main work being the driving of bolts and handling the timbers. The longitudinal stringers under the track, forming the box which carries the ballast, are not sized to regular thickness, and all irregularities are taken out in the surfacing and alinement of the tracks on the ballast. Consequently, the bridge gang is composed of a foreman and one bridge carpenter, with a certain number of negro laborers, who, however, are paid about 10% more than ordinary laborers. It is the intention, at the end of the life of these bridges, to tear them out and entirely rebuild them; and, assuming that they will require to be renewed once in ten years, the economy in repairs will more than compensate for the increased first cost. I do not think, however, that it would be economy to use them in Northern latitudes, where pine timber is used, or in any climate where the material used is such that the bridges would have to be renewed more than once in ten years.

There is some advantage in the construction of the trestle used by the Houston & Texas Central R. R., owing to the fact that it might be possible to renew any individual stringer, should it be necessary to do so.

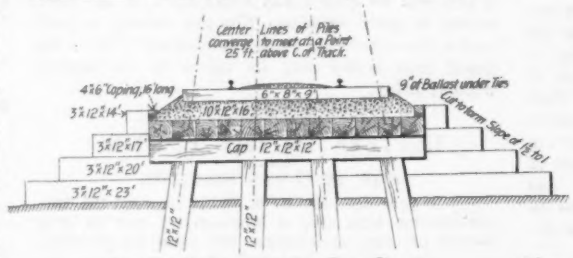
Where these bridges are unusually long, or where the track is more than 8 ft. above the level of the ground, longitudinal bracing is used in every sixth panel; but on the lower and shorter bridges this has not been found necessary. This form of construction is not original with the Illinois Central R. R., the plan being based upon the style of structure used on the Southern Pacific, with certain modifications to give increased strength and stiffness. Yours truly,

J. F. Wallace, M. Am. Soc. C. E.,
Chief Engineer Illinois Central R. R.

Chicago, Ill., April 9, 1895.

BALLASTED CULVERT; SOUTHERN PACIFIC RAILWAY.

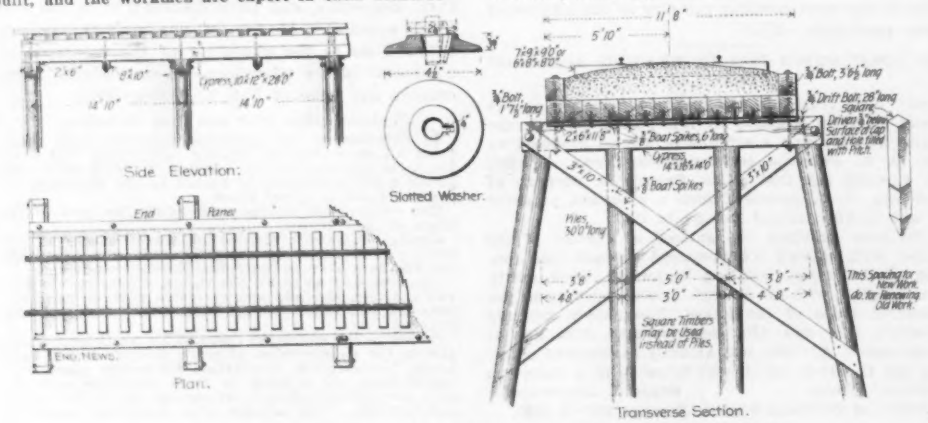
Sir: I enclose you blueprint of our standard creosoted ballasted culverts. Our trestles, which are constructed exactly the same as far as the solid floor system goes, cost us, for heights varying from 4 to 12 ft., from $8 to $8.50 per lin. ft., built under traffic, the lower cost applying to trestles of four or more panels and the higher cost to trestles of less than four panels. We use ballasted decks on creosoted trestles only. The cost of our ordinary untreated three-stringer trestles, built of common lumber, the decks being neither creosoted nor ballasted, is in the neighborhood of $4 per lin. ft., for heights varying from 4 to 12 ft. Our creosoted trestles with three stringers under each rail, pile bents, heights 4 ft. to 12 ft., cost about $6.75 per lin. ft. The bents in the trestle shown in the accompanying illustration are 16 ft. out to out.



Ballasted Culvert; So. Pac. Ry.

Yours truly, J. Kruttschnitt,
General Manager Southern Pacific Co.

Houston, Tex., April 24, 1895.


Side Elevation.
Slotted Washer.
Plan.
Transverse Section.
Square Timbers may be Used instead of Piles.
This Spacing for New Work, do for Renewing Old Work.

STANDARD SOLID FLOOR TRESTLE, ILLINOIS CENTRAL R. R.

THE FRICTION OF WOOD UPON WOOD AT HIGH PRESSURES.*

By Edwin H. Messiter, Elizabeth, N. J., and Richard C. Hanson, New York city, Graduates of the Columbia College School of Mines, New York city.

These experiments were made (1) to determine the value of the static friction of wood upon wood at high pressures, and (2) to throw, if possible, some light on the law of the variation of friction with pressure. Eighty-one experiments were made at pressures varying from 100 lbs. per sq. in. to 1,500 lbs. per sq. in.

Apparatus and Methods.—As it was manifestly impossible to secure the necessary pressures by the old method of drawing a weighted block along a plank, a special machine was designed for making these tests. An isometric projection of this machine is shown by Fig. 1. The middle block, A, is pulled by the bar, B, which passes through A and is secured by a nut on the other side. The steel lever C is suspended from the hanging lever D by means of the leather straps E E, taking hold of a pin which passes through C at its center of gravity. The weight F just balances the lever C. Near the lower end of C pieces of hardened tool steel are set in to bear against a casehardened knife-edge in the eye of bar B and against a steel knife-edge in the casting G, which is secured to the end of the two struts H H. The spring balance J is connected with a pin in the upper end of C, and the strain is put on by the strap K passing over a piece of brass pipe at L and fastened to a differential tackle, M, which is secured to the ends of the two struts H H. The ing machine giving pressure to the blocks between which A was placed are shown at O O and the columns at P P. By this arrangement the support of the lever C is practically frictionless, while by means of the tackle M the strain can be put on the spring balance gradually and positively. An electric bell was arranged with a contact on the block A, and the lower block, and adjusted so as to ring when a slip of about 1-50 in. occurred.

The observations were made in the following manner: The testing machine was run until its beam indicated the desired pressure. The nut on the bar B was then screwed up, if necessary, to bring the lever C back of the vertical so that it would become vertical when the lost motion was taken up. The readings were all taken with the lever C in a position very nearly vertical.

While the strain was being put on by means of the tackle, the beam of the testing machine was kept balanced by turning the screws slowly with a hand-wheel, when necessary. When the block slipped, the needle of the spring balance suddenly moved toward its zero. The ringing of the electric bell was simply a check on this indication.

The motion of the middle block was generally so small as to be imperceptible to the eye, but there was never any doubt as to the point at which motion occurred, as the spring-balance needle could be repeatedly brought up to a certain point, from which it would at once fall, showing plainly that the block had slipped, independently of the ringing of the bell.

The spring balance was calibrated by hanging standard weights from it, and the correction thus found was applied to all readings. Before each series of experiments the machine was balanced for the weight of all apparatus and everything else on the platform.

Results of Tests.—The accompanying diagrams, Fig. 2, show the frictional resistance obtained by each test and indicate the relation of the grain of the wood to the surfaces in contact.

The specimens used in Series A, B, C, D and E were made from the same stick of timber. The wood was comparatively dry, though probably not thoroughly seasoned. The middle blocks were 5-in. cubes with two sides beveled, and the top and bottom blocks were 5 × 5 × 2½ ins.

* Graduating Thesis Awarded First Honorable Mention in Engineering News Thesis Competition for 1894. The latter part of the thesis, in which the results of the experiments were applied to the design of timber joints, is omitted here, and the manuscript is considerably condensed from the original.

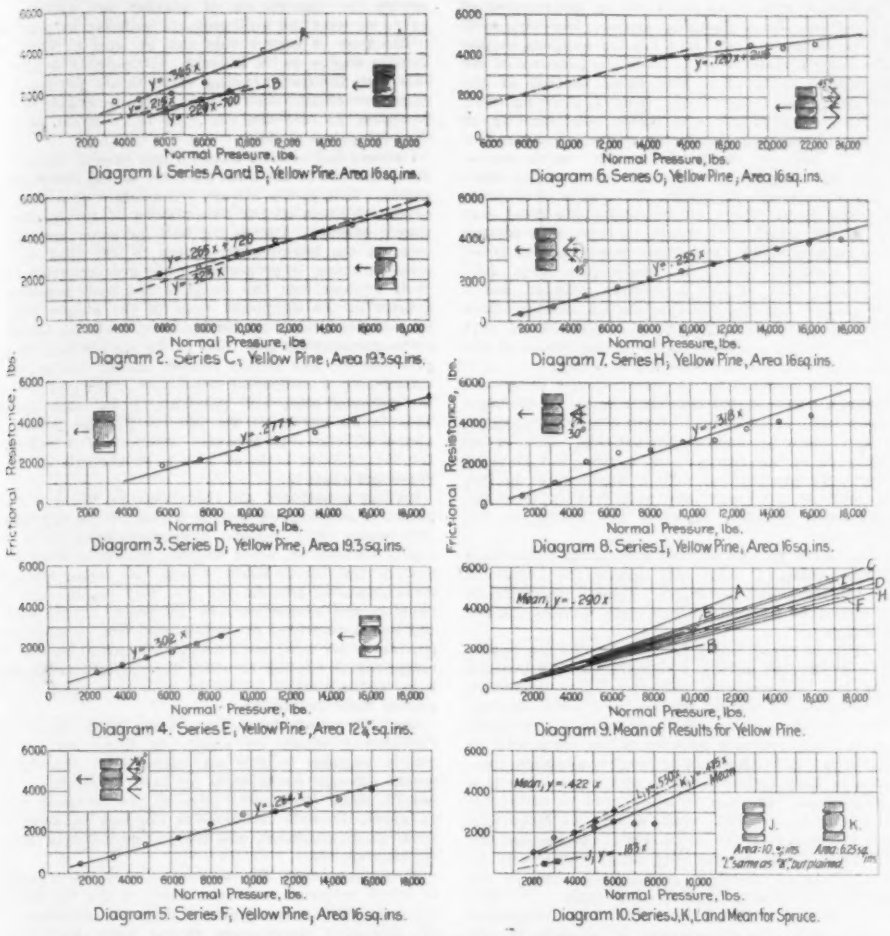


Diagram 1. Series A and B, Yellow Pine. Area 16 sq. ins.
Diagram 6. Series G, Yellow Pine, Area 16 sq. ins.
Diagram 2. Series C, Yellow Pine, Area 19.3 sq. ins.
Diagram 7. Series H, Yellow Pine, Area 16 sq. ins.
Diagram 3. Series D, Yellow Pine, Area 19.3 sq. ins.
Diagram 8. Series I, Yellow Pine, Area 16 sq. ins.
Diagram 4. Series E, Yellow Pine, Area 12¼ sq. ins.
Diagram 9. Mean of Results for Yellow Pine.
Diagram 5. Series F, Yellow Pine, Area 16 sq. ins.
Diagram 10. Series J, K, L and Mean for Spruce.
Normal Pressure, lbs.
Frictional Resistance, lbs.

FIG. 2. DIAGRAMS SHOWING RESULTS OF TESTS OF FRICTION OF WOOD.

The specimens used in Series F, G, H and I were from the same wood. This wood was very heavy and full of pitch, but not green. The middle blocks were 6-in. cubes, made in two parts, so as to present similar surfaces on opposite sides, and beveled as before. The top and bottom blocks were $6 \times 6 \times 3$ ins., with the grain making the same angle with the surface as in the corresponding middle block.

Series J, K and L were made on fairly dry spruce, the specimens being somewhat smaller than the preceding.

In Series A the surfaces were extremely rough, being the original surfaces, as the stick came from the lumber yard. For Series D, the same specimen was used, the surfaces being planed smooth. In the remaining experiments the surfaces were all smooth, either planed or sandpapered. In every case the surfaces were found to be polished after the series of tests had been made upon them, and in the case of the very pitchy specimens the surfaces were found to be sticky, especially after the tests at very high pressures.

The results were reduced in the following manner. Through each series of points a straight line was drawn in such a way that the deviations from it were as small as possible and evenly balanced on both sides. The full lines in the diagrams of Fig. 2 were drawn in this way. It was found that in most cases a line could be drawn through the origin which would satisfy the points very well. In those cases in which the line did not pass through the origin, another line was drawn, passing through the origin and a point in the original line midway between the extreme readings of the series, to be used in determining a mean value of the coefficient as explained below.

In Series F the pressure was carried up to 1,000 lbs. per sq. in. The blocks were then taken out, and the polish was removed from the rubbing surfaces by planing down and sandpapering. The specimens were then put in place and a pressure of 14,400 lbs. was applied and allowed to remain for 10 minutes. Readings were then taken at regular intervals forming Series G.

Discussion of Results.—These experiments seem to point toward the conclusion that the coefficient of static friction is practically independent of the pressure between the limits of 100 lbs. per sq. in. and the pressure at which deformation of the surface commences. It is to be observed that most of the results do not show the irregularity that has been found in previous experiments, or, in other words, that at high pressures the relation between pressure and friction becomes definite and regular. This makes it appear that the disturbing influences which make the friction of rest erratic at low pressures become insignificant in proportion to the total friction at high pressures.

Another noticeable fact is that the plotted results do not fall indiscriminately on both sides of the mean line, but that they generally follow a sinuous line crossing the mean line at one or more points. This is simply noticed as a matter of interest. It would require a very extended series of experiments to justify any positive conclusion in a matter of this kind. It appears that the nature of the surface, if reasonably smooth, has much less to do with the amount of friction than at low pressures.

In Series K and L the mean of results for a planed surface gives a slightly higher coefficient than the mean for a surface just as left by a cross-cut saw. In Series A and B there is apparently a considerable difference in the coefficient, due to the nature of the surfaces, but in Series A the surfaces were so extremely rough that it is probable that no motion could take place without wholesale deformation of the surface.

Similarly the effect of time of contact seems to be relatively small. In Series G the specimens used in Series F were sandpapered to remove the polish they had acquired, and for the first reading the load was left on for 10 minutes. The broken line, Diagram VI., shows the mean for Series F, and it is seen that the first reading of Series G falls almost exactly upon that line. These inferences, however, need to be strengthened by further experiments before they can be given much weight.

For the purpose of obtaining a mean value of the coefficients for practical application, the coefficients of x in all the series were averaged, weighting each according to the number of experiments from which it was derived. This mean value for yellow pine is 0.2897. The mean value found by giving each equal weight is 0.2898. The corresponding angle of friction is nearly 16° 10′. On Diagram IX. the results are grouped, the lengths of the lines showing approximately the range of the experiments in each series. Series G was omitted, as its readings are outside of the range for which it is desired to obtain a mean value. For spruce the mean coefficient is 0.422, and corresponding angle of friction is nearly 23°. This is derived from only nine experiments and two of the experiments showed a coefficient as low as 0.183.

These coefficients do not necessarily apply to pressures below 100 lbs. per sq. in. nor above about 1,000 lbs. per sq. in. in yellow pine, or 600 lbs. per sq. in. in spruce.

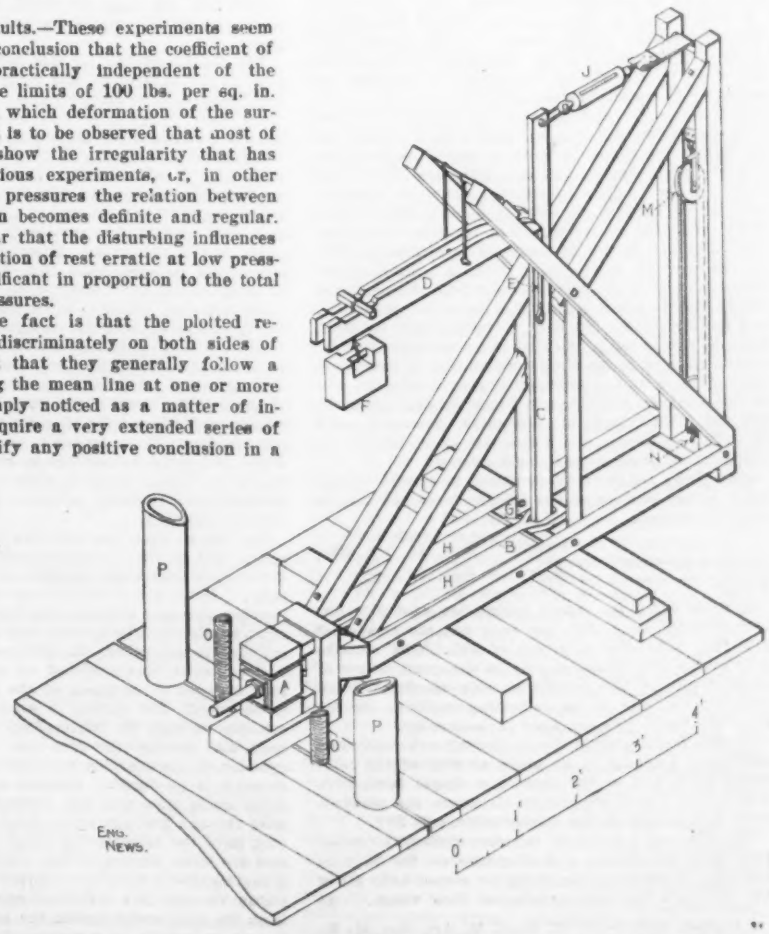


FIG. 1. MACHINE FOR TESTING FRICTION OF WOOD UPON WOOD.

THE EFFICIENCY OF COMPOUND LOCOMOTIVES.*

The compounding of locomotives presents to the railway companies of this country the greatest means of fuel economy that has been placed within their reach. Long since used in engines for all other purposes with marked success, the compound principle in using steam was unused in locomotives until recently, especially in this country. Of late, however, the country has been somewhat flooded with compounds, some of very inferior designs. The result of this has undoubtedly been to cause a reaction. Several compounds have been changed to simple engines, and many railway men are either in a skeptical state of mind or condemn such locomotives in an unqualified manner. Wherever this condition exists, it can always be traced to an experience with locomotives having such bad qualities that their use was simply intolerable. Fortunately, there are a sufficient number that are proving to be unobjectionable, and are so highly advantageous in many ways that their continued use is assured and will be gradually extended. A type of engine that can clearly save fully one-quarter of the coal now used by simple locomotives, that materially reduces water consumption, diminishes boiler and slide valve repairs, reduces smoke, cinders and the fire risk, that steams better than the simple engine in hard places, without a necessary increase of any kind of repairs, must surely become the favorite as soon as people know which design to select.

The reasons why a compound locomotive that is properly designed will save steam compared with the best simple locomotive, no matter what kind of service is considered, are as follows:

1. The steam can be more conveniently used with great expansion, and therefore high steam pressure can be more advantageously utilized.

2. Division of the expansion between two cylinders diminishes condensation in both cylinders by reducing the range of temperature in each cylinder.

3. Division of expansion between two cylinders renders it possible to evaporate, or re-heat, a portion of the moisture in the exhaust of the first cylinder, and thus render it capable of doing work in the second cylinder. As this can be done in the locomotive with waste gases the gain is all profit. By using the proper kind of receiver this is an effective means of economy.

4. Steam that leaks through the valve of the first cylinder is, in a properly designed locomotive, worked expansively in the second cylinder.

5. Steam that is re-evaporated toward the end of the high-pressure piston stroke, too late to work expansively, instead of being exhausted to the atmosphere as in the simple locomotive, is worked expansively in the low-pressure cylinder.

Concerning the first reason, the expansion in the compound locomotive can be secured with a later cut-off than in the simple locomotive, and with this comes a wider port opening and less wire drawing of the steam. It is feasible to expand steam in a single cylinder by cutting off early, but such efforts have always resulted in wastefulness by great condensation, thus giving rise to the familiar expression "expansive working is expensive working." D. K. Clark showed, as early as 1850, that a cut-off of about one-third stroke in a simple engine is the most economical, and the same thing has been recently shown by Prof. Goss, in this country. So that if a high degree of expansion is used in the simple locomotive, it means extravagance in steam, although it may save some coal by low terminal pressure and gentle exhaust action on the fire. The compound locomotive, however, saves 15 to 20% of steam, and above this saves coal by its low terminal pressure and gentle exhaust.

Concerning range of temperature, in certain typical cases in my possession the temperatures and ranges were as follows:

	Simple.	Compound—h.-p. cyl.	Compound—l.-p. cyl.
Initial temperature....	374°	368°	312°
Lower.....	230°	298°	230°
Range.....	144°	70°	82°

In these cases the simple locomotive used 27½ lbs. of fuel-water per I. HP. per hour and the compound 19½ lbs., producing a saving of 29%. This remarkable saving is attributable only to the small ranges of temperature in the cylinders, with resultant small condensation, and to the re-heating receiver, for the total expansion was the same in both cases.

In simple locomotives the condensation in cylinders sometimes amounts to as much as 60% of the total steam used, and in the case of a simple locomotive with which I have experimented, where the passages were well protected, the condensation was 38%.

The effect of a re-heater is rather difficult to determine in a locomotive, and of course no rise in temperature or super-heating would be shown until all of the moisture had been converted into steam. As there is much moisture in exhaust steam, it is not likely that it will be all dried out by the receiver of a locomotive. In a pumping engine, however, such difficulty disappears, and in a Leavitt pumping engine at the Boston Water-Works, while the pressure in the low-pressure steam chest was equal to that of the atmosphere, the temperature, instead of being 212°, was 306°, showing the remarkable super-heating of 94°. As a compound locomotive receiver is bathed in gases of 550° to 600°, while the moist steam within has a temperature of only some 280°, it is unnecessary to argue that some re-evaporation takes place. When we remember the great capacity of the metal of a steam cylinder to condense and re-evaporate, we have ample reason for the belief that a receiver, having a temperature fully 200° higher than that of any locomotive cylinder, has a much greater capacity for evaporating moisture than a cylinder. It is clear, from these considerations, that a receiver in the smoke-box of a locomotive is of the greatest importance in promoting economy.

In the fourth reason for the economy of a compound locomotive, I have stated that the leakage by the high-pressure valve should pass into the low-pressure cylinder, and there be worked expansively. This is necessarily so in the two-cylinder engine, but in some four-cylinder locomotives, with a single valve to two of the cylinders, leakage may pass directly from the high-pressure cylinder, or even the boiler, to the atmosphere.

While I have pointed out the economical advantages of compounding, I must not ignore the losses to which the compound is subject. These losses have in cases converted compounds into more wastful engines than simples.

The first of these losses is that due to the imperfections of the link motion, which are strongly brought out in the high-pressure cylinder. These imperfections are great in simple engines also, notwithstanding the protestations of some of my locomotive friends, but in the high-pressure cylinder of the compound, as compression begins on steam of receiver pressure, compression is likely to be excessive, and reduces the area of the indicator diagram seriously, and in early cut-offs at ordinary speeds, even, a loop is frequently formed showing negative work, thus reducing the net work. This is one reason why many compounds at certain points of cut-off do much more work in the low-pressure cylinder than in the high. It also furnishes a part of the reason why some compound locomotives are less economical, in relation to the simple engine, in light work than in heavy. In the latter case the point of cut-off is sufficiently late to avoid excessive compression and a loop in the diagram.

The usual remedies for this defect are, inside clearance to the slide valve, and large clearance volume in the cylinder. The former causes the exhaust to close later, thus trapping in less steam in the clearance spaces, and the latter gives a larger volume to fill by compressed steam and thus reduces the maximum pressure. There is another remedy that ought to be applied in addition, as follows: The high-pressure valve should be set out so as to give negative lead in full gear, and to give zero lead when cutting off at about 45% of the stroke. Slipping the eccentrics back sufficiently to accomplish this, delays the beginning of compression, and therefore its maximum amount.

Another loss, which is often great, is that between the cylinders, causing the combined indicator diagram to have a large gap between the bottom of the high-pressure and top of the low-pressure cards. This loss is so great in many cases as to amount to some 30% of the possible work of the steam, after high-pressure release, and will nullify all gains that may come from compounding. It is probable that less than half a dozen compound locomotives in the country have this loss so small as to make it, when coupled with another phenomenon, virtually nothing. The latter will be noticed presently.

The loss between the cylinders is so insidious, so to speak, and so little comprehended, that it should be dwelt upon sufficiently to make its causes and nature clear. It cannot be done away with, even in slow-running pumping engines, for even there some work must be absorbed in transferring the steam from one cylinder to the other. In addition to this cause the various resistances produced by obstructions and abrupt changes in direction of the steam passages are to be noted. The steam, in passing out of the first cylinder through the intercepting valve, where this is used, and through the open port of the low-pressure cylinder, is considerably retarded and a great loss of pressure is produced. Engines having piston valves suffer much from this loss, because the steam has to pass through gratings which form the ports. Engines that have the intercepting valve on the low-pressure side are much subject to this loss, because the steam is rapidly drawn from the receiver by the low-pressure piston through this restricted opening. If this valve is on the high-pressure side, the steam passes through it only as rapidly as it escapes from the small cylinder, and this is only some one-half to one-third as rapidly as it is drawn into the large cylinder. This shows the importance of placing the intercepting valve as near the high-pressure cylinder as possible.

The type of engine that can be used at will as a simple engine is, in general, considerably subject to this loss, for the changing valve forms tortuous passages and abrupt obstructions when the engine is compounded. In this case also, the valve should be near the high-pressure side.

I should not omit to notice a loss seldom thought of, viz., that due to the back pressure on the low-pressure piston. This piston always has a larger area than the combined areas of the two pistons of the equivalent simple engine. Unless the back pressure per square inch on the low-pressure piston is less than on the simple pistons, in proportion to the greater piston area, it is evident that the work of the back pressure is greater in the compound than in the simple engine. In general, I think the back pressure will be found to be proportionately less than in the simple engine, but this possible loss should furnish caution against over-cylindering a compound locomotive, especially on the low-pressure side, and particularly for high speeds. This is an argument for obtaining large power by means of large high-pressure cylinders, and indirectly for the cylinder ratio of 2 to 1, or thereabout, for a passenger engine.

Having considered all the losses to which a compound is subject, we are in a position to appreciate the reason why certain compound locomotives are highly economical, when working slowly or even moderately fast, with heavy trains. In these cases, in consequence of late cut-offs, yet with considerable expansion, and somewhat slow movement of the steam, the losses described are small, and bear a small proportion to the total work done. The result is that the compound is enabled to bring out those valuable qualities undiminished, which in numerous cases it has proved itself to possess.

Most compound locomotives have a low-pressure port ridiculously small, so small, in fact, that, while simple engines require an extravagant velocity of steam through ports, even as high as 1,500 ft. per second, some compounds have it two to three times as great. In such locomotives the loss between the cylinders is enormous, and the engine becomes useless for high speeds.

The compensation for the loss between the cylinders, to which reference has been made, is the increase in the area of the low-pressure diagram, produced by the fact that compression should occur only up to the initial pressure in that cylinder. The late exhaust closure fills out the heel of the diagram and may add to its area the amount lost between the diagrams. In my experience, the loss between the cylinders at 232 revolutions per minute was only 8%, while in many compounds at this speed it is fully 30%. The above 8% was exactly made up as just described. In the same case the cards realized 87% of the theoretical isothermal card, having the same ratio of expansion and back pressure, and this was fully as much as a simple engine realized under the same conditions. Such a result is remarkable for a compound engine, even in stationary service.

This discussion has brought out the fact that the compound locomotive is subject to losses to which the simple engine is not, and which may render it unfit for fast work. Such defects can, however, be fully overcome by large and easy passages, and the oft repeated statement that the compound is fit only for freight trains is highly erroneous.

From one point of view compound locomotives can be divided into two classes, viz., the automatic, that starts by allowing live steam to pass to the large cylinder only until the engine has made a half revolution or thereabout; and non-automatic engines, that can be operated at will as simple locomotives as long as desired.

I have always taken the position that the non-automatic engine does not allow the compound system to fully realize its object, and that any locomotive which does not immediately become a compound after making an initial movement is to some extent a failure.

It is held by the advocates of this type that the automatic engine does not start well, and that it cannot pull a sufficiently heavy train over ruling grades. Neither of these features has come within my experience, although that has been with freight trains on a continuous grade of 96 ft. per mile, 12 miles long, and with heavy fast suburban passenger work with 11 stops in 9 miles. It is no exaggeration, in fact, to say that the starting of the automatic engine has been uniformly surer than that of the simple engine in this service.

The point here considered is of the greatest importance in surburban or elevated railway work, for here the compound is particularly economical if it is a compound from the beginning. If it is a simple engine for some little time, the greatest part of its peculiar adaptation to the work which requires frequent starting is lost. This will be referred to again.

From another point of view, compound locomotives

* A paper read by F. W. Dean, M. Am. Soc. M. E., at the May "Engineering Evening" of the American Society of Mechanical Engineers.

are divided into two, three, or four-cylinder engines. Here appears a radical difference in detail, and one that must not be passed over without discussion.

In designing an engine for any kind of work, it is fundamental that the smallest cylinders that will properly expand the steam should be used, and that the smallest number of cylinders should be used. By pursuing any other course more cylinder, piston, and piston-rod surface is obtained than is necessary. As cylinder condensation is the greatest of all enemies of economy, by using multiple cylinders we invite our greatest enemy to be always with us. It is at least approximately true that cylinder condensation is proportional to surface, other things being equal, and dealing with common sizes, the cylinder, piston and piston-rod surfaces of a four-cylinder compound engine will be found to be about 33% in excess of those of the two-cylinder type. It is evident that the four-cylinder compound is therefore very seriously handicapped, when competing with the two-cylinder compound.

No further logic should be necessary to show that the four-cylinder compound cannot be justified from an economical standpoint, and has no reason for existence except as a means of producing a balanced engine.

If a two-cylinder compound requires a larger low-pressure cylinder than can be accommodated, two low-pressure cylinders can be used in its place, cast together, one above the other, and yet with advantage over the four-cylinder engine.

I now wish to consider the various kinds of railway service with reference to the economy of the compound locomotive. Assuming that the compound is of the automatic type, the order of economy is as follows, the greatest being first: (1) Elevated railway service, (2) suburban railway service, (3) freight railway service, (4) express passenger railway service.

The economy on the elevated railway is due to the great amount of starting and acceleration of trains. The simple engine can only do this when working steam at full stroke or late cut-offs, while the compound engine will expand the steam some 2¼ times when starting, and much more soon afterwards. Bearing in mind the great economy of steam gained by the early stages of expansion, the economy of the compound is evident. The following table shows the relative values of a pound weight of steam at different points of cut-off:

Point of cut-off.	Value of 1 lb. in weight of steam.
Full stroke	1.000
½ "	1.659
⅓ "	2.000
¼ "	2.207
1-5 "	2.343
1-6 "	2.435
1-7 "	2.495
⅛ "	2.532
1-9 "	2.552
1-10 "	2.560

This table shows that when the simple locomotive starts, it is using steam in such a way that one pound in weight does work of a value of 1, while the compound obtains from the same weight of steam work represented by 1.659 at least. In most cases it will be more than this, say, 1.768 for 2¼ expansions.

The saving in steam is therefore $\frac{1.768-1}{1.768} = 43\%$.

Soon after, the simple locomotive is expanding the steam twice and the compound fully four times. The steam quantities are then 1.659 for the simple and for the compound 2,207. The saving in steam is then $\frac{2.207-1.659}{2.207} = 25\%$. The actual savings made by some compounds in elevated service show that these figures are not far from the truth.

In express passenger service the quantities would be somewhat thus:

$$\frac{2.435-2.207}{2.435} = 9\%.$$

The remainder of the saving in steam would come from the other causes mentioned in this paper, but chiefly from reduced cylinder condensation.

If we add to this effect the economy due to reduced cylinder condensation, and diminished ejection of sparks from the stack, the economy of the compound is still more marked, and it is evident that in elevated service the non-automatic compound loses a great part of these advantages.

Following out this reasoning, the order of my list of services will be justified. Unfortunately, if the simple locomotive uses the upper grades of expansion, some 40 or 50% of this steam will be condensed in the cylinders.

The saving of fuel by the compound locomotive is materially affected by its increased evaporation per pound of coal, which amounts to some 15%. Added to this a saving of some 15% in steam consumption, it appears an easy matter to save 30% in coal.

In closing, I desire to refer to the claim made by many persons that the saving by compounds is due to larger boilers and higher pressures. There have now been so many trials of engines of both types with boilers and pressures the same, that this view is gradually being abandoned. I have myself conducted trials of simple locomotives, with pressures of 140 lbs., 160 lbs., and 175 lbs., and have been unable to perceive any material difference in water consumption. Perhaps the most conclusive trials of this character were carried out by the Caledonian Railway, in Great Britain, where the same engines have been tried with pressures varying from 150 lbs. to 200 lbs., over long periods in the same service. I have been informed by the late locomotive superintendent of that line, that their conclusion was that the most economical pressure for a simple locomotive is from 150 to 160 lbs.

The grand fact to remember in all of these considerations is that the compound locomotive can use as little as 20 lbs. of steam per hour per I. HP., while the simple locomotive cannot use less than 27 lbs., and in passenger work such a result for the compound can be attained by avoiding a net loss of work between the cylinders.

Discussion.

Mr. O. F. Nichols, (Brooklyn Elevated R. R.)—The compound locomotive is specially applicable to elevated railways from the less amount of dust, ashes, smoke, steam, etc., emitted, from the fact of using half the number of exhausts—and also from the fact that these exhausts are emitted at not more than one-half the pressure of simple engines. In 1890 three locomotives of the Brooklyn Elevated Ry. were changed to compounds by the Rhode Island Locomotive Works, and the experience with these engines was so satisfactory that in 1892, 19 new two-cylinder compounds were ordered. Three, built by the Pittsburg Locomotive Works, were of the non-automatic type, referred to by Mr. Dean, and the remainder, by the Rhode Island Works were automatic. The new engines weighed 28 to 29 tons, about four tons more than other engines used on the road. The increase of weight was to draw five-car trains over heavy grades.

Observations of these engines after they were put in service showed the following comparative results:

	Compound. seconds.	Simple. seconds.
Time starting (to reach full speed).	26	28
Time at full speed	38	44
Time slowing down to stop	21	18

The longer time in slowing down was due to the fact that the engineers hesitated to apply the brake as hard upon the heavier compound engines as upon the simple engines.

These compound engines made an average speed of 15 miles an hour on a 6-mile run, making 19 stops, a feat which no simple engine on the road could ever perform. The average saving of the compounds in fuel and water averages 20% in regular service, and the late Mr. Batcheller, of the Rhode Island Locomotive Works, the designer of the engines, claimed and fairly demonstrated that a saving of over 30% was made.

In 1893 there was a good deal of criticism of these engines, and they were put out of service for six months. The trouble with them was a disagreeable jolt in starting, and its cause was for a long time a mystery. I finally came to the conclusion, however, that it was due to lack of care in operating the engine. I have seen runners make four and five stops without disturbing a person, and then on the sixth or seventh stop bring the train up with a jolt that would almost throw you on your head, showing at once, the engine being on the same run, that there must be a great deal of it in the individual runner, and I determined that it was very largely prejudice on the part of the men—that they were determined not to run those engines smoothly. I would not advise using compound engines in connection with simple ones, or the reverse; because if men become accustomed to one type of engines it is difficult for them to become reconciled to another type; and the simple engine requires a little less knowledge to understand. The runner does not need to know about the intercepting valve. The result is, he avoids it, and does not use his best efforts to make it do its best work. I think a great deal of our trouble with compounds has been due to that.

As further proof that the above diagnosis is correct, the three engines changed from simple to compound, referred to above, never gave the slightest trouble of the sort referred to.

Mr. Jos. C. Platt inquired whether the saving made by the compound would be greater on a level road or on a road with undulating grades. Mr. Dean thought that it would be greater on a level, as the greater economy of the compound in climbing grades would be more than offset by the fact that the fuel consumption would be about the same in both engines when drifting down hill. President Davis referred to the performance of a two-cylinder compound on the mountain division of the Chesapeake & Ohio, where the profile is like a coarse-tooth saw. Its saving over simple engines was very satisfactory in all classes of service. The engine, however, was of "non-automatic" type, so that on very steep grades it could be used as a simple engine, and thus haul heavier trains than if it were worked as a compound engine all the time.

Mr. Gus C. Henning asked as to the economy of the compound locomotives on the Abt Rack Ry. on Pike's Peak. Mr. S. M. Vauclain (Baldwin Locomotive Works), said that the first compound locomotive built for that road showed a saving of fuel of 35% to 38% over the simple engine used, and about 25% less water consumption, thus necessitating one stop less for water and fuel in the 9-mile run up the mountain. The time of the up-trip was reduced to 1 hour and 50 minutes, compared with 2½ hours with the simple engine. All this was so satisfactory that the company had all its simple engines rebuilt as compounds.

Mr. Vauclain said further:

As I am the patentee of one of the most extensively used systems of compounding for locomotives, and that a four-cylinder system, I am naturally favorable to the four-cylinder system, but I do not take the position that the two-cylinder compounds are no good. I believe that a great deal of the trouble that we have experienced with the two-cylinder compounds in this country and abroad has been due to the fact that not sufficient engineering skill was spent upon the designs when the engines were worked out. In this country locomotive builders are apt to take an order for a locomotive and build it very rapidly. It is impossible to build satisfactory compounds upon a basis of that kind, unless you have gone through the experimental period, and understand exactly what you are doing. The Baldwin Locomotive Works has built over 500 four-cylinder compounds and two two-cylinder compounds. The style of valves we used was very much criticised, and it was said that it would prove a total failure, and would interfere very much with what few chances the engine had of being a successful compound locomotive. On this point I cannot agree with Mr. Dean. We do not believe that there is any loss in using the piston valve due to the numerous apertures through which the steam has to pass and the restrictions placed on the free passage of the steam by the bridges in the steam chest, because by using the piston valve we are able to get a very much longer length of port than we can with the ordinary slide valve, and with very little valve friction. We are also able to operate steam pressures that it is impossible to operate with the ordinary slide valve. The Northeastern Ry., of England, has a number of two-cylinder compounds, built by Mr. T. W. Worsdell, but it has been found necessary to change them, and they are now being fitted with single expansion cylinders and piston valves. Indicator diagrams taken from those locomotives are far superior to any indicator diagrams I have seen taken from simple locomotives with slide valves. The four-cylinder system is used on the Paris, Lyons & Mediterranean Ry., in France, and splendid engines those are, but very complicated. Mr. Sigmund Cadena (now deceased), who was Chief Superintendent of the Hungarian State Railway engine works in Buda-Pesth, assured me that he had failed to adapt the two-cylinder compound to high-speed passenger service, and had to resort to the four-cylinder compound for the purpose, and found it very satisfactory. But for us to attempt to build an American four-cylinder compound with tandem cylinders or inside cylinders with crank axles, or anything of that sort, would not have done at all. We would not have been able to find a market. The idea occurred to me that by placing the cylinders adjacent to each other, one immediately above the other, and connecting the two pistons to a common cross-head, supplying steam to both cylinders by a single piston valve, we could get very good results. It is this type of engine that has produced some of the highest rates of passenger speed on record. The Philadelphia & Reading R. R. is using the four-cylinder compound exclusively for its fast trains between Philadelphia and Jersey City. The Central R. R. of New Jersey is using the four-cylinder compounds for the same work; and thinking that perhaps the efficiency of these engines was due somewhat to the design of the boiler and other details, and not to the compounding, single expansion engines of the same type exactly, excepting that the latter were given the advantage of 2 ins. greater diameter in the boiler, were built and placed in the same service. But they were unsuccessful, and the compound engines are hauling the trains, while the simple engines are doing other work. We have made numerous tests, and the economy ranges all the way from 10% up to 43%. In the case where there was 43% economy, it was on a grade 12 miles long, 100 ft. to the mile, with very heavy curves. The engines were loaded to their utmost capacity. The compound locomotive working full stroke worked very economically, whereas the

simple engine worked at a very great disadvantage, and not at all economically. In most of the two-cylinder compounds the ratio of expansion between the two cylinders is from 2 to 2.5, very seldom getting beyond that. I believe the Pennsylvania R. R. has one a little higher, probably about 2.65 or 2.70. We aim at a ratio of 2.8 to 3, which gives us a very economical expansion of the steam. We find the engines very well adapted to elevated railway service. In Chicago, the South Side Elevated Ry. has 45 of these compound locomotives, and one simple engine, which was first made a two-cylinder compound in order to compete with the four-cylinder, but the trials of these engines led the company to have the two-cylinder engine changed to a single expansion, and finally used it for switching service in the yard, and not in regular train service. We have made exhaustive tests of the Wootten fire box on compound engines and simple engines, and effected an economy of about 24%. We also found that the compound engine could burn an inferior grade of fuel, and the Blue Line trains between New York and Philadelphia are using nothing but buckwheat coal, which costs about 35 cts. a ton, whereas before they used the best quality of egg coal. The Philadelphia & Reading R. R. operates 78 compound locomotives.

The lowest water rate per indicated horse power that we have taken off has been at very slow speeds—say, from 60 to 80 revolutions per minute in freight service, on the New York, Lake Erie & Western R. R., and those engines run as low as 17½ lbs. of water per indicated horse power per hour. That result was obtained, of course, by being able to get a very fine indicator diagram on account of speed. There was very little loss between the two cylinders, and the back pressure in the low-pressure cylinder was very slight. The most economical point of cut-off in a simple engine was about one-quarter stroke, and that was about 27 lbs. of water per I. HP. When we cut off at half and three-quarters stroke the water rate had very much increased, due to condensation and less expansion. At shorter cut-offs the increase in water rates was very much more rapid than when working beyond one-quarter stroke. In the compound engine we found a variation of about 2 lbs. in the water rate between three-eighths and three-quarters cut off; so that the compound has a greater range of economy; that is, it could be worked at various points of cut-off, and still be a very economical working engine; whereas the simple engines could only be worked economically at one-quarter cut-off.

The highest boiler pressure we have used is 220 lbs., and that was with the piston valves. In England it was found that at 170 lbs. they had reached the limit for slide-valve service, and after they got beyond 175 lbs. they had trouble with the valve getting dry and cutting. For the Chicago, Milwaukee & St. Paul R. R. we built some simple and compound engines for 180 lbs. pressure, and the compound showed an average fuel economy for the entire year of about 17%. Mr. Barr thought that perhaps by running his simple engines at 200 lbs. pressure he would get just as good results as with the compound, but they had great trouble, as the valves got dry.

Mr. Davis.—I think the 200 lbs. pressure of the simple engine compared with the compound is liable to be misleading, because in the compound engine you have the pressure divided half and half between the two cylinders, while the low-pressure cylinder would not have more than the receiver pressure on the back of its valve on the other side, and, although there is 220 lbs. on the top of the valve, there would be about half of that under the valve in the receiver; so that the difference would be considerably less than in an ordinary simple engine. So I rather fail to see why a compound engine could not carry 220 lbs. with a slide valve as well as the simple engine could carry 150 or 160 lbs. I have been interested personally in the testing of a compound engine recently, which carried 220 lbs. of steam, with the ordinary slide valves balanced in the usual way. Part of the time they had the American balance, and part of the time the Richardson balance. The ports were 23 ins. long, and that engine carried for one month, under very severe service, 220 lbs. boiler pressure, and for the remainder of the time 200 lbs. There was no appreciable cutting of the valve faces, and it was concluded that that pressure was not excessive for that type of valve in that case.

Mr. Dean.—I have had something over 3½ years' experience with a compound locomotive carrying no less than 180 lbs. of steam, and a good deal of the time carrying 195 lbs. Mr. Henney, who succeeded Mr. Lauder on the Old Colony system, desiring to ascertain the relative merits of the compound and the simple engine, has had both taken into the shop and put into the very best condition. When the valves of the compound engine were taken out the foreman of the shop was quite undecided whether it was best to face off the seats or not. The valves and the valve-seats were simply admirable after this long term of service.

Mr. Bishop.—The greatest trouble we have had with the Webb cylinder compound on the Pennsylvania R. R. is being unable to start with the low-pressure cylinder, driving the front pair of wheels. The valve motion was run with the link motion and two eccentrics, and that was afterwards changed to a loose eccentric, with a step for forward and back motion; so, of course, the engine would have to be started before the eccentric would come to a start governing either motion. So, in backing up to the train the eccentric was set for the back motion, and unless you started the train the back wheels would go forward and the forward pair of wheels would go backward, and of course it was impossible to make any progress, and if the low-pressure wheels happened to get on the center the receiver would fill up and no progress would be made in any direction, so that it was found to be almost impossible to use it on any of our trains, and it has been out of service most of the time. The valve motion on that engine, as the men were not able to hear the exhaust, was in very bad shape. Indicator cards from the engine showed excessive back pressure in the high-pressure cylinders, and that the valves were not square; so that perhaps that would account for not being able to get a speed of much over 60 miles per hour out of the engine. The engine was very rough riding, having a very jerky motion.

Mr. Forney.—Of course, for any one to state that you cannot save fuel with a compound locomotive would be to talk nonsense, but there is a decided difference between saving fuel and saving money in locomotive service. I think the probabilities are that for certain kinds of service the compound engine will be found ultimately to be the most economical engine, but for much of the service of railways I think it is still questionable.

Mr. Davis.—The criticism as to the increased weight of the compound engine refers simply to the difference of weight in cylinders, which puts a little more weight on the front truck. But the difference of weight is really in the boiler. The compound engine can utilize a boiler of higher power to more advantage than the simple engine, for which reason it is perfectly fair to give the compound engines the higher boiler power. In the compound engine of the best type, there is always reserved the possibility of throwing that engine into a simple engine and getting about 25% more power for emergencies. In that way the weight of the train can be increased, when there are many points where the grade is so heavy that it would limit the average train, and it is perfectly legitimate that the compound engine should take advantage of its capabilities of being able to overcome that by a temporary increase of power. While that uses a little more steam for the time being, it enables the engine to carry a higher average amount of tonnage, and the slight waste of steam is more than overcome by the increased tonnage for the rest of the trip. Whatever advantage the compound engine shows is in spite of the greatest amount of opposition that an engine could possibly have. In spite of that, we find that the compound engine is gaining ground.

Mr. Vauclain.—I believe that the cost of repairs to the compound engines of the Philadelphia & Reading R. R. is about 75% to 80% of that cost of the simple engines. On the passenger engines it is probably not over 60%. The compounds have a slight advantage in having a little larger wheel. We look for a decided saving in boiler repairs, but in cylinder repairs we look for an increase, due to having four pistons to take care of in place of two. Mr. Soule, of the Norfolk & Western R. R., found that the total cylinder repairs to an engine did not exceed 5% of the total repairs, and as I would concede twice the cylinder repairs to the compound as to the simple engine, it would not make any great figure in the comparison of repairs, whereas the boiler repairs were less in a very much greater proportion. We think that the compound locomotives would require about the same repairs as the ordinary single expansion engines.

C. H. Quereau.—(Communication).—The following gives the principal results of careful road tests of two simple and two compound locomotives, made in freight service, with a dynamometer car, water meters, etc., in accordance with the code adopted by this society. The averaged results of the tests will be found in Table I. The compounds were of the two-cylinder type, with a receiver in the smoke arch. A trip consisted of a run of 117 miles with 28 loaded freight cars, a different train being taken each trip. There were several 1% grades each way. The same engine crew handled all the engines, and the same testing crew of four persons took the records. All springs, gages, and water meters were calibrated, coal from the same mine was used on all the engines, and great pains taken to have all conditions as nearly uniform as possible. The principal engine dimensions are as follows:

Engine	No. 1.	No. 2.	No. 3.	No. 4.
Type	2-cyl. comp. Ten-whl.	2-cyl. comp. Mogul.	Simple. Mogul.	Simple. Consol.
Run'g wt., lbs.	200,000	172,000	182,000	175,550
Wt. on drivers	118,000	98,000	106,500	150,800
Diam. drivers...	56 ins.	62 ins.	62 ins.	63 ins.
Cylinders, ins.	19 & 30 x 24	20 & 29 x 24	19 x 24	20 & 28 x 24
Valve travel...	5½ ins.	6 ins.	5 ins.	5½ ins.
Valve, bal.....	Plain	Plain	Allan	Plain
Exh. nos., diam	5 ins.	4⅞ ins.	5 ins.	5 ins.
Diam. boiler...	58 ins.	56 ins.	60 ins.	60 ins.
Grate area, sq. ft.	31.3	31.5	31.5	34.7
Htg. surf., sq. ft.:				
Tubes	1,756	1,380	1,555	1,391
Firebox	172	126	136	164
Total	1,928	1,506	1,691	1,555
Miles on flues..	8,000*	7,318	5,941	42,231
Miles on firebox	8,000*	133,322	56,526	150,353
Pops released at	185 lbs.	185 lbs.	185 lbs.	185 lbs.

* Estimated.

Because of the great differences in the distribution of the heating surfaces, and differences in their condition, due to scale accumulating during varying periods of service, as shown, the evaporative efficiencies of the boilers and the coal used by the different engines are not comparable, and are not given. The conditions as to work done, speed and steam pressures were reasonably uniform for the several engines. The compounds were more economical than the simple engines in the use of steam by 15%, and this saving was not due to the use of higher pressures for the compounds, and should therefore be attributed to the compound principle. The figures given in Table I. for water used per unit of power developed are based on the assumption that all the water was used in hauling the cars. In columns 8 and 9 is given the water used per unit of power developed in hauling the total load, which includes the engine as well as cars, based on the weights of the engines and cars, and therefore only a close approximation.

From the dynamometer records the average pull for each engine for all its trips was found, and indicator cards from each engine were selected, which showed on the dynamometer record practically the same pull as the average. The average indicated water per I. HP.-hour was then calculated for each engine from these cards, and the results are given in columns 10, 11 and 12.

Inasmuch as the indicated water is a fair basis on which to compare the efficiency of engines in expanding the steam used, it follows from the last three columns that the steam was expanded by the compounds 9% more economically than by the simple engines. Columns 8 and 9 show that the compounds used steam 15% more economically than the simple engines. It would seem just to believe that the difference between 9%, the saving of the compounds due to better expansion, and 15%, the total steam economy of the compounds, was due to a saving because of less cylinder condensation. That the effect of the receiver in the smoke arch was beneficial in reducing condensation there can be little doubt, but tests of compound engine No. 2 have shown that there was no superheating of the steam as it passed through the receiver. It seems reasonable to assume that, had the boilers of the compound and simple engines been the same, the economy of the compounds in coal would have been at least as great as their economy in the use of steam.

In Table II. are given results obtained from records made by compound and simple locomotives in regular freight service obtained from the roads owning the engines. In each case the compound and simple engines compared were identical, except in modifications of cylinders and valve-gear made necessary by compounding; they were also operated on the same divisions and in the same service. The Chicago, Burlington & Quincy engines were run in the same pool, each engine crew taking each engine in turn.

As in Table I., the simple and compound engines used practically the same boiler pressure, and the difference in economy is due to the compound principle. The Cleveland, Cincinnati, Chicago & St. Louis compound has been in service about two years; the Chicago, Burlington & Quincy compound about four years, and the Chesapeake & Ohio compound about two and one-half years. Table II. further shows that the compounds hauled as heavy trains as the simple engines.

TABLE I.

Engines.	No. of trips.	Dyn. HP.hrs. per trip.	Water per dyn. HP. hr. lbs.	Water per dyn. HP. hr. P. c.	Speed, miles per hr.	Steam pressure.	Water per dyn. HP. hr. lbs.	Water per dyn. HP. hr. P. c.	Average pull of engine.	Pull for card.	Indicated water.	
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	
1 Compound	5	2,105	33.7	102.4	20.6	171	30.0	101.4	8,340	8,600	16.92	17.20
2 "	6	1,906	32.9	100.0	23.2	170	29.6	100.0	7,520	7,500	17.50	17.20
3 Simple	4	1,918	38.6	117.3	19.4	171	34.7	117.2	7,350	7,500	18.80	18.90
4 "	5	1,922	38.5	117.3	18.4	170	35.2	118.2	7,000	6,900	19.00	18.90

The writer would draw the following conclusions:

1. There are compounds in service which are more economical in the use of coal and water than simple

TABLE II.

Railroad	C., St. L.	C., C. &	C., B. & Q.		C. & O.	
Period of records	9 months.		1 month.		1 year.	
	Comp.	Simple.	Comp.	Simple.	Comp.	Simple.
Engines, service	1	12	1	40	1	10
Steam press., lbs	180	180	180	160-180	155	150
Av. train, load'd	24.7	24.8	31.6	25.1	35.1	36.1
Lbs. coal, car-m.	3.7	4.8	3.27	4.6	3.7	4.9
Best simple coal record	...	4.2	...	3.85	...	4.4
Repairs, 100 miles	$3.90	$4.09	...	...	$1.61	$2.27
Over average of all simples ..	23%	...	29%	...	25%	...
Over best simple record	12%	...	15%	...	16%	...

Because of several changes in valve gear, and a wreck, charged to repairs, it would be very difficult to determine the cost of repairs for the C., B. & Q. compound. It is the opinion of those having the engine in charge, that its repairs cost no more than for the simple engines, if as much.

engines of the same dimensions and doing the same work in freight service.

2. The minimum economy of the compounds is not far from 15%. It is probable that about two-thirds of this economy is due to a better expansion of the steam, and about one-third to less loss by condensation.

3. The compounds have been in service too short a time to warrant final conclusions as to their cost for repairs, but the experience to date and theoretical considerations strongly indicate that this item will be no larger for the compounds than for the simple locomotives of the same dimensions and doing the same work.

THE RAPID TRANSIT SITUATION IN NEW YORK CITY.

The New York Rapid Transit Commission has formally submitted its adopted plans and specifications to the Common Council of the city, which, according to the law, must take action to approve or disapprove them within four weeks from the time of their receipt, or not later than June 6. In submitting its plans the Commission says:

The board is of the opinion that the rapid transit railway, the routes and general plan of construction of which it now submits for your consideration, can be completely built ready for operation (exclusive of the equipment, which is to be furnished by and be the property of the contractor who shall operate the same) for less than the sum of $50,000,000. Mr. Parsons, its chief engineer, has so reported; and his opinion is corroborated by the opinions of the experts employed by this board (Messrs. Abram S. Hewitt, Octave Chanute, Thos. C. Clarke, Wm. H. Burr and Chas. Sooysmith). The estimate of cost includes about $6,000,000 for the expense of removing, replacing and renewing sewers, pipes, and other subsurface structures in the streets. The estimate also includes an allowance for the private property necessary to be acquired for stations and other purposes, excepting, however, such rights, if any, of abutting owners in the streets, whether in vaults or otherwise, as it may be necessary to acquire in order to secure to the contractor the right, free of lawful interruption or claim, to construct and operate the road. For such rights, in the opinion of the board, sufficient provision is made by the act of May 3, 1895.

In view of the serious questions involved in the use of Broadway below Fourteenth St., this board has given most careful consideration to the question of an alternative route in this part of the city. Study and reflection have led it to confirm the judgment of its predecessor in selecting Broadway. In the opinion of the board, the route along Broadway from Bowling Green to 34th St. is necessary to the success of the enterprise, being the main thoroughfare of the city. To the east and to the west there already exist rapid transit facilities. Legal difficulties, apart from all questions of advantage, have prevented resort to Elm St.

The principal features of the plan of construction are these:

1. The tracks are to be placed substantially upon a level.

2. The railway is to be placed as near the surface as street conditions will permit. This renders the road more accessible to passengers than would any other plan of construction. At nearly all of the stations the road will be reached by stairways much shorter than the shortest stairways providing access to the present elevated railroads, both on account of the grades and because, in going down to a railroad, the passenger reaches the platform before the tracks are reached, whereas, on the elevated roads the platforms are reached by climbing higher than the tracks.

3. The total depth of excavation necessary for the construction of the railway and its foundations will be in general only about 18 ft., except in the center of the street, where the depth will be about 2 ft. greater. From the plan it will be seen that the elements which involve risk to the neighboring buildings have been almost completely eliminated. The possibility of such risk or inconvenience does not deserve consideration, except in Broadway, below 34th St. All the modern buildings on that street, and, indeed, all the buildings upon it except the very old ones, have foundations varying in depth from 20 to 30 ft., or more. Where the house foundations extend to a greater depth than those of the railway, there will be no interference with private property for the purpose of underpinning house walls; nor is any damage to abutting property to be apprehended in any case by the construction of the railway. By the proposed arrangements for the various pipes and other subsurface structures the railway will be closer to the surface of the street by about 6 ft. than according to the plan formerly approved by your honorable body and by the Supreme Court.

4. Below Park Place, on Broadway, the present plan includes only two tracks. These will be placed in a tunnel 25 ft. wide, and in the center of the street, and as the excavation will extend below the surface of the street only about 18 ft., old and large buildings like Trinity Church and the Astor House will not be exposed to the slightest danger.

5. The placing of the railway close to the street surface permits and requires an arrangement of sewers, water mains, gas pipes, electric conduits, and other subsurface structures in Broadway, from Park Place to 34th St., which will be most advantageous to the city and to the owners of property on Broadway. The subsurface is now so crowded with pipes that it is impracticable to lay there additional mains or to increase the size of the present mains, which were laid years ago, and adjusted to the requirements and conditions of other times. The immense increase in the height of buildings, which was then unforeseen, has developed such a demand for water, gas, and electric power in the lower parts of the city that the pipes and conduits are already overtaxed, so that both the authorities of the city and the companies interested in the conduits are at a loss how to meet future needs. As the construction of the railway necessitates the removal of the subsurface structures in any case, it is proposed, as shown by the drawings, to construct, in connection with the railway and at the side of, or beneath, the tracks, large and well-appointed galleries, in which all such pipes and conduits will be placed. These galleries, when at the side, will facilitate the better ventilation and lighting of the tunnel, and the space afforded by them will facilitate construction and repairs. But, in addition, the permanent deposit of the subsurface structures in the galleries will be a great convenience to the city and the abutting property owners. Where such galleries have been constructed, additional pipes may be laid and existing pipes inspected, altered, and repaired, and new house connections made, without disturbing the surface of the street. Access to the galleries will be had through proper manholes at the intersections of streets, as well as from the railway tunnel. The renewal of the subsurface structures will be of great advantage to the city and to abutting property. The new pipes will be of the best modern type, and the leakages and injury incident to the age and character of the present pipes will be avoided. It is probable, also, that the city will avail itself of this opportunity to enlarge the sewer and water supply pipes, although the comparatively small additional expense which would be incident to such enlargement could not be considered a part of the cost of the railway. The new mains, if thus enlarged, would provide means of supply adequate for the future as well as for the present. The proposed galleries will be carried along Broadway from Park Place to 34th St. In making a contract for the construction and operation of the railway the board will reserve to the city all revenue to be derived from the use of the galleries for any purpose except a purpose necessary to the actual operation of the railway. The abutting owners on Broadway, after the construction of the road, will enjoy the great, and, for New York, the unprecedented, advantage of a street the surface of which need be disturbed only at long intervals, and then only to renew the pavements as they become worn by surface traffic.

6. The method of construction proposed by the board is neither experimental nor untried. The work will be attacked at as many points along the route as may be considered desirable. The progress of construction will be expedited to the utmost and the inevitable discomforts reduced to a minimum. The running of the surface cars is not to be suspended. On Broadway south of 34th St., except at Canal St., no more of the street surface is to be interfered with at one time than one-half on one side or the other of the center line of the street. Openings are not to be more than 200 ft. long, and consecutive openings are to be separated by free and undisturbed spaces of at least 500 ft.

7. The railway tracks are to be of standard gage, so that the railway cars can be large and commodious.

The Act of May 3, 1895, which is referred to above, increases the powers of the Commission in several particulars, and especially gives it authority to spend some $5,000,000 in acquiring the vault space along Broadway, which is necessary for the plan of construction which it has adopted.

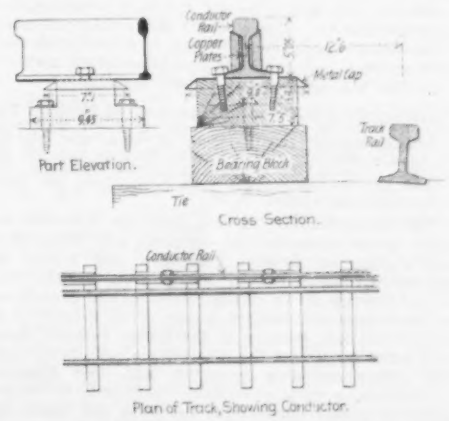
After the approval of the Common Council is gained, the Commission will next proceed with the work of securing the consents of the property holders along the route it has laid down, or the approval of a Supreme Court Commission if a majority of consents of the property-holders cannot be had. After this is done, detailed plans and specifications will be prepared, and the contract will be let in accordance with the terms of the law.

ELECTRIC TRACTION ON A MINING RAILWAY IN FRANCE.

The Paris, Lyons & Mediterranean Railway is operating by electricity a part of a branch, 1.6 miles long, extending from the Clapier Station, on the St. Etienne & Langeac line, and used extensively for hauling coal from mines. We take the following particulars from the "Revue Generale des Chemins de Fer," which obtained its information from Mr. Auvert, one of the railway company's engineers, who was in charge of the electrical work. From Clapier to Montmartre, about 0.62 mile, the line rises by a grade of 6.6%, and descending trains of eight loaded coal cars haul up eight empty coal cars by means of a cable passing over a horizontal pulley at the summit. From Montmartre to the mines the maximum grade is 1.4%, and until the early part of 1894 this section was operated by steam locomotives similar to the switching engines used at stations. One of the two tunnels on this section is subject to frequent falls, owing to the disturbance of the earth by the mine workings, and it was decided to line the tunnel with timber for about 500 ft., and as this would prevent the use of ordinary locomotives, it was also decided to adopt electric traction.

A generating plant supplies the current to a bare conductor placed near the ground parallel with the track, on insulated supports. An electric locomotive, with two axles, and weighing 15 tons, takes the current by means of iron shoes suspended from the frame, from which they are insulated by oak and ebony supports, and these shoes rest by their own weight on the lateral conductor, upon which they slide. The generating plant includes the boiler of an old Crampton locomotive, a 50-HP. Weyher & Richmond compound engine, making 275 revolutions per minute, and a direct-coupled, Hillairet-Huguet, 30 KW. bipolar dynamo of 360 volts.

The insulated conductor consists of a line of T-rails, fastened by lag screws to square blocks of



Electric Conductor: Paris, Lyons & Mediterranean Ry.

oak soaked in paraffin, which in turn are fastened by lag screws to wooden bearers resting on the ends of two ties. The blocks thus come between every other pair of ties, and each is capped by a metal plate, with edges bent down to shed the rain water clear of the block. The head of the conductor is 9.2 ins. above the head of the track rail, and its center is 12.8 ins. from that of the latter. The conductor is sometimes on the left of the track, while at three-

throw switches it is between the rails. The fish-plates and the ends of the conductor rails were carefully cleaned at the time of laying, and copper plates are fitted between the fish-plates and rails. The return current is through the track rails, which are spliced in the usual way, and by a ¼-in. copper wire laid in the ballast and connected at intervals with the rails.

The locomotive consists of a motor and gearing mounted on the iron frame of a four-wheeled baggage car. The motor is of the Hillairet-Huguet tripolar type, with a power of 25 KW., at 720 revolutions. The pinion drives a large spur wheel, on the shaft of which is a small double sprocket wheel, with two chains leading to larger sprocket wheels on the car axles. The double sprocket wheel runs free on the intermediate shaft, being driven by it by means of a Bovet magnetic coupling, when the current is turned on. This enables the gearing to run free, without running the motor, when the engine is running by gravity down grade. The speed can be regulated at will, and the engine can run in either direction. There are two brake-shoes on each wheel, and sandboxes at each end of the frame.

This engine hauls up from Montmartre to Beraudiere eight empty cars at a speed of 3.72 miles per hour, on the 1.4% grade, and 5 miles per hour on the other parts. It takes down eight loaded cars at a speed of 5 to 6½ miles per hour. There are from 12 to 15 trains per day each way. This system has been in successful operation since the end of January, 1894. It has been observed that the daily consumption of coal is slightly less than with the former steam locomotives. Rain or snow is said not to interfere appreciably with the insulation, and to cause but little trouble in the operation of the line, a statement which will probably be taken with some grains of allowance by American engineers.

BOOK REVIEWS.

THE THEORY AND PRACTICE OF LETTERING: Designed for the Use of Engineers and Draftsmen Generally, but Especially for the Use of Students in Engineering. By C. E. Sherman, Columbus, O. Published by the author. Small 4to; paper, cloth back; pp. 24; six full-page plates; 60 cents.

In reviewing one of the recent books on lettering, we remarked that, while the instructions given in the text were entirely inadequate and often misleading, the plates showing various styles of letters were of very considerable value. Of this book the reverse is true. In the text much instructive matter is presented, but the six plates that accompany it are poor The execution of the plate illustrating "Freehand Letters" is particularly unsatisfactory, and no description at all is given of inclined Gothic lower case, which is probably the best type for freehand lettering, and the one that can be most easily and rapidly executed. The author's preaching, however, is much better than his practice, and the hints and information given in the text will amply repay careful reading.

THE CONSTRUCTOR, a Hand-Book of Machine Design. By F. Reuleaux, Professor Royal Technical High School, Berlin, Hon. M. Am. Soc. C. E. Translated by H. H. Suplee, M. Am. Soc. M. E. Philadelphia, Pa. Published by the translator, H. H. Suplee, 339 Chelten Ave.; 4to, cloth; pp., 312; 1,200 illustrations; $7.50.

"Der Konstrukteur" of Prof. Reuleaux is familiar to most American mechanical engineers acquainted with the French or German languages, and indeed is known by reputation to nearly every machine designer through the numerous references and quotations in American and English books. This volume is a translation into English of the fourth enlarged German edition, with all the illustrations reproduced and the metric measures converted into their English equivalents, a work of immense magnitude in itself, with the almost innumerable equations and tables in metric values.

Any attempt to outline the contents of the volume, even in part, is impracticable here; about all that can be said being that it is a theoretical and practical treatise on machine design almost encyclopedic in its exhaustiveness. Perhaps the departments which stand out with especial prominence are: The treatment of ratchets and ratchet gearing; the discussion of what the author calls "tension organs" of machine elements, i. e., cords, ropes, wire, bands, belts, chains, etc., and their relation and connection with other elements in guiding, winding, driving, etc., and the antithesis of "tension organs" or "compression organs" for the transmission of force and motion. Throughout the book the attempt has been made to give the results of actual experience and practice and to present the working formulas and constants in forms suitable for practical and convenient use. The use of higher mathematics is very limited; indeed, a pretty careful search has failed to discover any processes or formulas above the easy understanding of the ordinary engineer.

As it stands the book is the best practical treatise on machine design of which we have any knowledge, and by this translation it is placed within reach of English-speaking engineers, to whom alone it has been inaccessible heretofore. The publisher's work is fairly good and the index is very full and complete. The fact that 2,500 separate items are indexed gives an idea of the scope of the book. We can recommend the book as being worth every cent of its price, and a valuable addition to any mechanical engineer's library.

THE WORLD'S COLUMBIAN WATER COMMERCE CONGRESS. Chicago, 1893. Report of the Secretary; inception and organization; minutes of the meetings and lists of members, with a full set of the papers presented. Boston: Damrell & Upham, 283 Washington St. Octavo; each paper separate in one portfolio. $5.00. Containing:

Report of the Secretary, organization, minutes, etc. 56 pp.
Status and Interests of Water Transportation; Thos. G. Vivian. 18 pp.
The Commerce of the United States as Related to that of Other Countries; William W. Bates. 10 pp.
The Commerce of the Mississippi River; Geo. H. Morgan. 31 pp.
Mississippi River Improvement below Cairo; C. B. Comstock. 10 pp.
The Chignecto Ship Railway; H. G. C. Ketchum. 16 pp.
The Projected Lake Erie and Ohio River Ship Canal; Thomas P. Roberts. 17 pp.
The Proposed Waterway from Lake Michigan to the Mississippi River, via the Illinois and Mississippi Canal; Alonzo Bryson, 6 pp.; by T. J. Henderson, 8 pp.
Canadian Waterways from the Great Lakes to the Atlantic; Thomas C. Keefer. 18 pp.
The Proposed Enlargement of the Waterway from Lake Michigan to the Mississippi River, via the Illinois River; L. E. Cooley. 18 pp.
Cable Towage on Canals and Rivers; the Hydraulic Canal Lift at Les Fontinettes, France; the Navigation of the Seine from Paris to the Sea; the Pneumatic Foundations at Genoa, and at La Pallice, the Port of Rochelle; Wm. Watson. 53 pp.
The Nicaragua Canal; A. G. Menocal. 38 pp.
The Nicaragua Canal; Nicaragua Canal Construction Co. 21 pp.
The Port of Havre; Baron Q. de Rochemont. 16 pp.
The Manchester Ship Canal; Elijah Helm. 22 pp.
Improvement of Waterways and Ship Canals; L. F. Vernon-Harcourt. 18 pp.
On the Utilization of Water and Rail Routes in Hungary and their Competitive Influence in Reducing Freight Charges; Dr. Alex. Halasz. 21 pp.
The New and Enlarged Waterways Required to Meet the Demands of Commerce in Russia; E. F. de Hoerschelmann. 17 pp.
Experimental Researches on the Form of Canal and River Boats; F. B. de Mas. 19 pp.
Electric Propulsion on Canals; O. Buesser. 15 pp.
Chain Towage with Magnetic Adherence; L. Molinos and A. de Bovet. 30 pp.

Within the limits permitted, it is impossible to separately note the contents of these diversified but important papers. Each one is written by an expert especially interested in the subject discussed and familiar with the conditions imposed. Maps and illustrations in nearly all cases further explain the text, and the whole collection forms an exceedingly useful work of reference upon some of the very latest engineering projects in the United States and Europe.

RESULTS OF A TRANS-CONTINENTAL SERIES OF GRAVITY MEASUREMENTS. By George Rockwell Putnam. And Notes on the Gravity Determinations Reported by Mr. G. R. Putnam. By Grove Karl Gilbert. Washington, D. C.: Philosophical Society of Washington. Bulletin No. XIII. Pamphlet; 8vo; 46 pp.

Pendulum measurements of gravity were formerly only made at great expense and consumed a long time in their determination and reduction. Owing to the almost prohibitory difficulties encountered with older methods, the subject was practically neglected for a half a century. Since 1880, more portable apparatus and shorter methods of obtaining results have revived interest in these determinations, and now almost every nation engaged in geodetic surveys has taken up the subject in earnest. Under Dr. T. C. Mendenhall, late Superintendent of the Coast and Geodetic Survey, and with a half-second pendulum apparatus designed by him, a line of pendulum measurements has been made across the American continent, near the 39° parallel, extending from Washington to San Francisco. Mr. Putnam describes the apparatus used and the methods pursued, and gives a continental section with the results reduced to sea level. While the author states that it is unsafe to draw general conclusions from a single series of observations, he draws a few general inferences. Mr. Putnam found a considerable deficiency of gravity in the Western mountains and plateaus, increasing with the elevation. As the mass above sea level would have to have a density of zero to offset this deficiency, he concludes that there is a deficiency in density below sea level, which in general compensates the elevated masses. On the other hand, local topographical irregularities, whether elevations or depressions, are not compensated for, but are maintained by the partial rigidity of the earth's crust. The value for the mean density of the earth, as derived from pendulum observations on Pike's Peak, was found to be 5.63, no account being taken of the estimated difference in density below the level of Colorado Springs.

Mr. Gilbert discusses and corrects the gravity determinations of Mr. Putnam from observations on the local geology. Mr. Gilbert, as a result of his investigation in the same field, rather favors the theory of isostacy, or equal pressures, than that of rigidity in the earth's crust, in accounting for local conditions. He believes that the continent as a whole is approximately isostatic, and that the interior plain is almost perfectly so. This condition of hydrostatic equilibrium, or equal pressures, would apparently explain all the local peculiarities of gravity. As the series of determinations here commented upon is the first in what is intended to be a system, later and fuller observations will furnish much better material for conclusions.

THE MECHANICAL ENGINEER'S POCKET-BOOK: A Reference Book of Rules, Tables, Data and Formulae, for the Use of Engineers, Mechanics and Students. By William Kent, A. M., M. E., Consulting Engineer, M. Am. Soc. M. E., M. Am. Inst. M. E. New York: John Wiley & Sons; 16mo; leather, pocket-book form; pp. 1087; 168 illustrations; $5.

(First notice.)

We advise any and every engineer who has a five-dollar bill that he can possibly spare, that, if he has paid up his subscription to Engineering News, he had better at once send for a copy of this book. The aim of the author has been to make a book covering all lines of mechanical engineering as thoroughly as Trautwine's book covers civil engineering, and he has, on the whole, succeeded admirably. We hardly know how to write at once a better and juster description, which will give our readers a clear idea of what Mr. Kent's work is, than this comparison with Trautwine, and realize that in so doing we are also praising the work in the highest terms, yet no more, we are convinced, than it deserves.

In size and general appearance the book is almost an exact copy of Trautwine. The leather cover, however, is a coarser material, with a narrower flap than that used on late editions of Trautwine. The paper is about the same weight that is used in Trautwine, and the type is one size larger, which adds materially to the legibility. The classification of the contents of the book is as follows: Mathematics, Materials, Mechanics, Heat, Physical Properties of Gases, Heating and Ventilation, Water, Fuel, Steam, the Steam Boiler, the Steam Engine, Gas, Petroleum and Hot Air Engines, Locomotives, Shafting, Pulleys, Belting, Gearing, Hoisting, Wire Rope Transmission, Rope Driving, Friction and Lubrication, the Foundry, the Machine Shop, Dynamometers, Ice Making or Refrigerating Machines, Marine Engineering, Construction of Buildings, Electrical Engineering. Under each of these main headings are, in most cases, numerous subdivisions.

It is a difficult matter, we are aware, to fix on a suitable classification of these subjects, but it seems to us that fewer general headings would have better served the purpose. Thus, under the one heading, "Generation of Power," several of these minor divisions could have been grouped, and "Transmission of Power" might have included several others. Proper classification in the Table of Contents is the more important, as the index to the volume is pretty brief for the amount of matter which it contains.

In the preparation of the work the author has refrained from treating civil engineering problems, leaving his readers to consult Trautwine for such information. Perhaps the most notable feature of the book is the care which the author has taken to quote the authority on which the rules, tables, formulas, etc., given in the work are based. In this way the user of the book can refer to the source of any data of which he wishes to make use, and can trace for himself their derivation. He is thus enabled to form an intelligent and independent judgment as to their reliability. So numerous are these references, and so well has the work been brought up to date, that it is really a pretty fair index to the technical literature of mechanical engineering which has appeared during the past few years.

Great pains has evidently been taken to make the work complete. The only suggestion which we can now make with reference to desirable additions are that the 45 pages devoted to electrical engineering might well have been considerably extended. The mechanical engineer of the future is not going to be content with a mere smattering of electricity. In fact, the best mechanical engineers to-day aim to keep well posted on the advancement in practical electrical engineering. Additions to this part of the work, however, and to such other portions as experience in its use shows to be desirable, will doubtless be made as future editions are called for.

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PERSONALS.

Mr. H. A. Potwin has been appointed Town Engineer of Cicero, Ill.

Mr. P. M. Parker has been appointed City Engineer of Fredonia, N. Y.

Mr. J. L. Prentice has been elected City Surveyor at Stevens Point, Wis.

Mr. O. R. Rauchfuss, City Engineer of Joliet, Ill., has sent in his resignation.

Mr. Guy H. Carleton, civil engineer, of Sault Ste. Marie, Mich., died of heart failure on May 1.

Mr. George Stanchfield has been elected City Engineer of Fond du Lac, Wis., vice Mr. E. B. Parsons.

Mr. J. P Ramsey has been appointed Engineer of Maintenance of Way of the Peoria & Pekin Union R. R.

Mr. George Y. Wisner, M. Am. Soc. C. E., has been appointed Sanitary Engineer of the Board of Health, Detroit, Mich.

Mr. William E. Johnson, for several years Assistant Engineer on the city water works, Hartford, Conn., has been elected Chief Engineer.

Mr. Bernard R. Wood has been appointed Assistant Engineer to the Nicaragua Canal investigating board. He has been for some time Principal Assistant Engineer on the Mexican Boundary Commission.

Mr. Joseph Crawford, M. Am. Soc. C. E., Superintendent of the New York Division of the Pennsylvania R. R., has been taken to an asylum. He has never fully recovered from injuries received during the erection of the trainshed at Jersey City.

Mr. A. R. T. Lackie has been appointed Chief Engineer of the Honduras Ry., with headquarters at Puerto Cortez. The line is about 70 miles long, and was originally intended to be a transcontinental line. It is reported that an extension is contemplated.

Mr. Alexander W. Cooke, until recently Chief Engineer of the Sewerage Department of the city of Chicago, has opened an office as a consulting engineer at 119 La Salle St., Chicago, Ill. He will make a specialty of water-works, railways, sewerage and paving work.

Dr. John W. Byron, a well-known bacteriologist, died in this city of consumption on May 8. He contracted the disease from inhaling germs while making microscopic examinations of tubercle bacilli. He was born at Lima, Peru, in 1861, and came to this country in 1890, after having studied in Europe and Cuba.

Mr. A. D. Thompson has been appointed City Engineer of Peoria, Ill. Mr. Thompson has been connected with the city engineer's office for two years as assistant engineer, having had especial charge of the paving and street work, and brings a thorough acquaintance with the work and needs of the city to his new office.

Col. Wm. P. Craighill, U. S. Engrs., Past President of the American Society of Civil Engineers, has been appointed Chief of Engineers of the U. S. Army, with the rank of Brigadier-General, succeeding Gen. Thos. Lincoln Casey, who has retired, as noted last week. A portrait and biographical notice of Gen. Craighill were given in our issue of Feb. 15, 1894.

Hon. James A. Weston, ex-governor of New Hampshire, who died at Manchester, N. H., on May 8, was born in that city in 1827. In 1846 he became Assistant Engineer of the old Concord R. R., and in 1849 he became Chief Engineer. As Chief Engineer of the Concord & Portsmouth R. R., he superintended the construction of the greater portion of that line, and later he built the Suncook Valley R. R. and constructed the Penacook Lake system of water-works.

Col. A. W. Sims, General Manager and Chief Engineer of the East Broad Top R. R., died at Rockhill Furnace, Pa., recently. He was born at Mount Holly, N. J., in 1826, and was a rodman on the Pennsylvania R. R. in 1847, Assistant Engineer on the Northern New York R. R. from 1848 to 1851, Chief Engineer of the Ottawa & Prescott Ry. until 1854, Chief Engineer of the Delaware & Hudson R. R. until 1868, engineer and contractor on the Vermont & Woodstock R. R. until 1870; Engineer of the Wallkill Valley R. R. until 1871; Superintendent of the Toronto & Nipissing Ry. until 1872, and from 1872 until the time of his death was connected with the East Broad Top R. R.

Mr. Walter C. Parmley has resigned as First Assistant City Engineer of Peoria, Ill., and will engage in independent engineering, with office in the Edwards Building, Peoria. Mr. Parmley has also been engaged by the T. B. Townsend Brick & Contracting Co., of Zanesville, O., contractors for the West Bluff sewer system of Peoria, which was designed by him, and he will have charge of the construction of this work for the contractors.

Mr. C. C. Stowell has been reappointed City Engineer of Rockford, Ill., with the additional duties of the office of Superintendent of Water-Works. Mr. Stowell has held the offices of City Engineer and Superintendent of Sewers since the autumn of 1890, and to these offices has now been added the office of Superintendent of Water-Works. Previous to his appointment as City Engineer in 1890, Mr. Stowell was for ten years engaged in railway engineering, having been engaged in construction and maintenance of way work on the Chicago & Northwestern, Rochester & Pittsburg, West Shore & Buffalo, and Chicago, Milwaukee & St. Paul railways during that time.

Mr. Eckley Brinton Coxe, civil engineer, coal operator and Past President of the American Society of Mechanical Engineers, and of the American Institute of Mining Engineers, died at his home at Drifton, Pa., on May 13, of pneumonia. Mr. Coxe was born in Philadelphia on June 4, 1839, and he was the son of Judge Chas. S. Coxe, and the grandson of Tench Coxe, prominent as a statesman and financier during the administration of President Washington. Mr. Eckley B. Coxe graduated from the University of Pennsylvania in 1858, and after some practice in fieldwork, in the anthracite regions of his native state, he spent two years, 1860-1862, in studying at the Ecole des Mines at Paris. He then took a course at the Bergakademie at Freiburg, and in all spent five years in the schools and mines of England and the Continent. In 1865 he returned home to take the active management of the large coal tracts inherited by himself and his brothers, in the anthracite fields of Lehigh county, Pa. He took especial pride in his work as a practical mining engineer, and introduced a number of refinements in instruments and methods, and was the first man to reduce the risk from fire by building his coal-breaker of iron and steel. He spent his life among his workmen and was devoted to advancing their material interests. He was a State Senator of Pennsylvania in 1881-1884; was a director of the Philadelphia & Reading R. R. Co., and President of the Delaware, Susquehanna & Schuylkill R. R. Co. Mr. Coxe was a Member of the American Society of Civil Engineers from Feb. 7, 1877. He was a member of the American Institute of Mining Engineers from its establishment in 1871, was a Vice-President during ten years, and President of the Institute during 1878 and 1879. He was also a member of the American Society of Mechanical Engineers from its establishment and was its President in 1893 and 1894. He was a Vice-President of the Mining Congress held in Paris in 1889; a member of the Engineers' Club of Philadelphia, and, in 1887, was one of the vice-presidents of the American Association for the Advancement of Science. As an author he has contributed many valuable papers on mining engineering, and, in 1872, he published a translation of Weisbach's "Mechanics of Engineering and Construction of Machines." He leaves a widow, but no children to inherit his large estate. A portrait and biography of Mr. Coxe were published in our issue of Jan. 12, 1893.

ENGINEERING SOCIETIES.

COMING TECHNICAL MEETINGS.

ENGINEERS' CLUB OF PHILADELPHIA.
May 18. Secy., L. F. Rondinella, 1122 Girard St.
ENGINEERS' CLUB OF MINNEAPOLIS.
May 20. Secy., E. Nelson, Kasota Block.
WESTERN RAILWAY CLUB.
May 21. Secy., W. D. Crosman, Club Room 9, Grand Pacific Hotel, Chicago.
COLUMBIAN ENGINEERING SOCIETY.
May 21. Secy., W. F. Hart, University Building, 15th and H Sts. N. W., Washington, D. C.
ENGINEERING ASSOCIATION OF THE SOUTH.
May 23. Secy., H. D. Ruhm, Nashville, Tenn.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
May 23. Secy., C. L. McLeod, 12 Mansfield St., Montreal.
INDIANAPOLIS ENGINEERING CLUB.
May 25. Secy., C. C. Brown, City Engineer.
AMERICAN WATER-WORKS ASSOCIATION.
May 28 to 31. Annual meeting at Atlanta, Ga. Secy., Peter Milne, New York, N. Y.
WISCONSIN POLYTECHNIC SOCIETY.
May 28. Secy., W. K. Means, Loan & Trust Building, Milwaukee.
ENGINEERING CLUB OF COLUMBUS, O.
June 1. Secy., David Buell.
ENGINEERING SOCIETY OF WESTERN NEW YORK.
June 3. Secy., Geo. R. Sikes, 122 Pearl St., Buffalo, N. Y.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
June 5. Discussion on "The Santa Ana Irrigation Canal." Annual meeting at Nantasket, Mass., June 18. Secy., C. W. Hunt, 127 E. 23d St., N. Y. city.
ENGINEERS' CLUB OF ST. LOUIS.
June 5. "Water Towers at Laredo, Tex., and St. Charles, Mo.," by Edward Flad. Secy., W. H. Bryan, Turner Block.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
June 7. Secy., O. H. Von Geldern, 819 Market St., San Francisco.
MONTANA SOCIETY OF CIVIL ENGINEERS.
June 8. Secy., Forrest J. Smith, Denver Block, Helena, Mont.
ENGINEERS' CLUB OF KANSAS CITY.
June 10. Secy., F. W. Tuttle, Baird Building.
MASTER CAR BUILDERS' ASSOCIATION
June 11. Annual Convention at Alexandria Bay, N. Y. Secy., J. W. Cloud, Rookery Building, Chicago, Ill.
NORTHWESTERN SOCIETY OF ENGINEERS.
June 11. Secy., D. W. McMorris, Burke Building, Seattle, Wash.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
June 11. Secy., F. A. Coburn, Case Library Building.
DENVER SOCIETY OF CIVIL ENGINEERS.
June 11. Secy., H. Breen, 36 Jacobson Block.
ASSOCIATION OF RAILWAY TELEGRAPH SUPTS.
June 12. Montreal, Que. Secy., P. W. Drew, Wisconsin Central Ry., Milwaukee, Wis.
ENGINEERS AND ARCHITECTS' CLUB OF LOUISVILLE.
June 13. Secy., Jas. K. Zollinger, Norton Building.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
June 14. Secy., D. W. Meeker, St. Paul, Minn.
AMERICAN RAILWAY MASTER MECHANICS' ASSOC'N.
June 17. Annual Convention at Alexandria Bay, N. Y. Secy., Angus Sinclair, 256 Broadway, New York city.
ENGINEERS AND ARCHITECTS' ASSOCIATION OF SOUTHERN CALIFORNIA.
June 19. Secy., F. Van Vleck, Los Angeles, Cal.
WESTERN SOCIETY OF ENGINEERS.
June 19. Secy., Chas. J. Roney, 1736 Monadnock Block, Chicago.
BOSTON SOCIETY OF CIVIL ENGINEERS.
June 19. Secy., S. E. Tinkham, City Hall, Rooms 36 Bromfield St.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
June 20. Secy., D. Carhart, Carnegie Library Building, Allegheny.
ENGINEERS' CLUB OF CINCINNATI.
June 20. Secy., J. F. Wilson, Odd Fellows' Temple.
AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
June 25-28. Annual Convention at Detroit, Mich., F. R. Hutton, Secy., 12 W. 31st St., New York city.

ENGINEERS' CLUB OF PHILADELPHIA.—At the meeting of May 4, Mr. Wm. H. Dechant presented a paper upon "Cribwork Cofferdams," such as have long been used on the Philadelphia & Reading canals. He described the method of construction and sinking. Mr. James R. Maxwell, a visitor, described "Railway Construction in the Peruvian Andes." He especially referred to the construction of the Ferro Carril Central del Peru, which starts from Callao, and in 106 miles from the coast rises to an elevation of 15,666 ft. above sea level. It then descends and in reaching Oraya falls 3,480 ft. in 30 miles. This road was commenced in 1870, and in 1875 track was laid to Chicla, when work was suspended. In 1890 work was resumed and the track reached Oraya on June 10, 1893. Eight of the 57 tunnels on this line are above an elevation of 15,000 ft. L. F. Rondinella, Secy.

AMERICAN WATER-WORKS ASSOCIATION.—The fifteenth annual convention of the association will be held at Atlanta, Ga., May 28, 29 and 30. It is expected that the following papers, which we have grouped by subjects, will be read: "Cost of Pumping Water for Cities, Towns and Villages," by Samuel G. Artingstall, M. Am. Soc. C. E.; "Use of Electric Pumping Machinery for Water-Works," by J. M. Goodell, Assoc. Am. Soc. C. E.; "The Possibilities of Electrical Pumping Machinery," by Chas. A. Hague, M. Am. Soc. M. E.; "Practical Experience with a Water Meter," by J. B. Newhall; "Our Experience with Water Meters," by Jno. B. Heim; "Meters," by Fred Crosby; "The Future Water Supply for Inland Cities and Towns," by Isaac B. Potts; "Cast Iron versus Wrought Iron or Steel Pipe," by P. D. Wanner; "Determination of the Loss in Pressure by Water Passing Through Check Valves Under Various Conditions," by John Knickerbacker, M. Am. Soc. M. E.; "Water-Works and Their Management," by L. N. Case; "The Right to Take Water from Streams and Lakes for Public Supply," by Rome G. Brown.

The headquarters of the association will be at the Kimball House, where the rates will be from $2.50 to $5 a day. Those desiring space for exhibits of water-works appliances should address the proprietor of the above hotel. Arrangements have been made for railway fares at 1½ one-way rates, on the certificate plan. It is expected that a party of members will leave New York at 4:30 p. m. Saturady, May 25, arriving at Atlanta at 4:55 p. m. the next day. This party will go by the Pennsylvania Railroad to Washington, and thence by the Southern Railroad. Mr. Peter Milne, Water Purveyor of Brooklyn, N. Y., is secretary, and Mr. Wm. Ryle, Superintendent of the Passaic Water Co. of Paterson, N. J., is president of the association.

WESTERN SOCIETY OF ENGINEERS.—A meeting of the society was held at the Armour Institute, Chicago, May 14. Mr. Daniel W. Meade, Assoc. M. Am. Soc. C. E., read a paper on the "De Kalb, Ill., Municipal Electrical Pumping Plant." The paper described the construction and operation of the new water-works system of that town, with especial reference to the operation of the pumps by electric power. A

brief description of the plant will be given in a future issue. On Saturday, May 18, the members of the society will make an excursion trip over the recently completed Metropolitan West Side Elevated Ry., visiting the rolling lift bridge, the power house and other points of especial interest.

CIVIL ENGINEERS' SOCIETY OF ST. PAUL.—At the meeting, on May 6, the report of the committee on Standard Wire Gages, indorsing that of the American Society of Mechanical Engineers, was read and accepted. Mr. J. D. Estabrook then read a description of the new steam plant at the Washburn flour mill in Minneapolis, and Mr. Wm. A. Pike described a test of its main feature, the Schichau engine.

C. L. Annan, Secy.

NEW PUBLICATIONS.

MAY MAGAZINES.—"The Century" this month has an irrigation paper entitled "The Conquest of Arid America," by Wm. E. Smythe. The writer reviews in a popular manner what has been accomplished in irrigation work in the principal Western states. Among the illustrations accompanying the paper is a very poor view of the Sweetwater dam, and a very good one of the flood of 1893 in Salt River, Arizona. Mr. A. C. Bernheim writes on "A Chapter of Municipal Folly—The Squandering of New York's Public Franchises." The author takes an enlightened view of the subject of public franchises, and urges that no franchises should be granted without adequate return, and that at periods not exceeding 21 years there should be a revision of the proportion of gross earnings to be paid to the city. In the editorial department are some excellent notes on the progress of sanitary legislation, and a brief discussion of forest depredations in the West, in which it is urged that the forest reserves be protected to save the sources from which the water supply for irrigation is drawn. In "McClure's" there is an interesting account of Gaston Tissandier, the French aeronaut. "The Forum" has a paper by Dr. R. H. Thurston, entitled "Our Debt to Inventors; Shall We Discourage Them?" Dr. Thurston explains the recent Supreme Court decision, and urges that the law be so amended that an American patent will not expire with the expiration of a foreign patent granted prior to it. We shall take occasion to comment upon the matter in our editorial columns at an early date. President Jordan, of Leland Stanford, Jr., University, discusses "Pettifogging Law Schools and an Untrained Bar." Engineers who are fond of crying down their profession, and urging that until it is equipped with a code of ethics, and established by law as a close corporation, it can have no standing, will be interested in the following extract:

> It is thus true, as President Eliot has said, that into an American law school any man "can walk from the street." But in most of the states he can do better or worse than this. From the street he can walk directly into the profession of law, disregarding even the formulae of matriculation or graduation. In many of our states it requires no more preparation to be admitted to the bar than to be admitted to the sawbuck. When the professions cease to be wide open to adventurers and thieves, they will rise to something of their traditional dignity. It has been said that the only "learned profession" in America at present is that of the engineer.

Mr. Ainsworth R. Spofford, the Librarian of Congress, writes on the work of the Government Printing Office at Washington, and discusses some of the same problems that we considered in an editorial last week.

In "The North American Review" Prof. Frank Waldo writes on "The Progress of Meteorology," Prof. Edward S. Holden tells us "the latest news of Mars," and news indeed it is, to the effect that the nice theories about Martian air, water, snow, canals and inhabitants, must vanish into thin air, or let us say into the cosmic ether, for the Lick telescope declares that Mars has no atmosphere, and hence is in all probability as dead and desolate a body as the moon itself.

Peterson's Magazine has two articles this month on railway topics. In "Hard Times and the Railroads" some facts and figures are given with which railway managing officers are only too familiar. The chief interest of the article, however, are the portraits which accompany it of 16 prominent railway presidents, including those at the head of the great systems. Another paper on "The American Locomotive," by Chas. W. Strine, is written for the popular reader, and is illustrated by half-tone engravings of typical American fast express locomotives.

CONSTRUCTION NEWS.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work.	Place.	See Eng. News.
May 17.	Pipe, etc., and pipelaying,	St. Louis.	May 2
May 17.	Building,	Pittsburg, Pa.	May 2
May 17.	Stone paving,	Brooklyn, N. Y.	May 9
May 17.	Brick paving,	Cincinnati, O.	May 9
May 17.	Street improvements,	Louisville, Ky.	May 9
May 17.	Brick sewer (1,500 ft.)	Milwaukee, Wis.	May 16
May 17.	Bridge,	Louisville, Ky.	May 16
May 17.	Iron beams, etc.,	Pittsburg, Pa.	May 9
May 18.	Stone buildings, at Santa Fe, N. Mex.		Apr. 25
May 18.	Lock, St. Louis, Mo.		Apr. 25
	Advertised, Eng. News, Apr. 18 to May 9.		
May 18.	Remodeling school building,	Cleveland, O.	Apr. 25
May 18.	Reconstructing water-wks.,	Brazil, Ind.	May 2
May 18.	Dike at Everett, Wash.		May 2
May 18.	Brick paving,	Wilkinsburg, Pa.	May 9
	Advertised, Eng. News, May 9.		
May 18.	Life saving station at Lake Como,	N. J.	May 9
	Advertised, Eng. News, May 9.		
May 18.	Pipe sewers, (9,000 ft.)	Des Moines, Ia.	May 9
May 18.	Grading, Washington,	Pa.	May 16
May 18.	Asphalt paving,	Indianapolis, Ind.	May 16
May 19.	Pipe sewers (14,500 ft.),	Waco, Tex.	May 2
May 20.	Water bonds, Santa Clara,	Cal.	Mar. 7
	Advertised, Eng. News, Mar. 7 to 28.		
May 20.	Court-house,	Wrightsville, Ga.	Apr. 4
May 20.	Street improvements,	Fostoria, O.	May 2
May 20.	Brick sewers,	Jersey City, N. J.	May 9
May 20.	Court house,	Wrightsville, Ga.	May 9
May 20.	Prison extension,	Trenton, N. J.	May 9
May 20.	Paving,	Elyria, O.	May 9
May 20.	Sewers,	Evanston, O.	May 9
May 20.	Gallery, etc., for armory,	Niagara Falls.	May 9
May 20.	Fire engine houses (4),	Brooklyn, N. Y.	May 9
May 20.	Electric lighting,	Scottdale, Pa.	May 16
	Advertised, Eng. News, May 16.		
May 20.	Laying water pipe,	Albany, N. Y.	May 16
May 20.	Sheet asphalt paving,	Syracuse, N. Y.	May 16
May 20.	Street improvements,	Chicago.	May 16
May 20.	Town and school bldg,	Wrentham, Mass.	May 16
May 20.	Building,	Atlanta, Ga.	May 16
May 20.	Electric lighting,	Phelps, N. Y.	May 16
May 21.	Dredging,	Montgomery, Ala.	Apr. 18
	Advertised, Eng. News, Apr. 18 to May 9.		
May 21.	Pumping engines, etc.,	Brooklyn, N. Y.	Apr. 11
	Advertised, Eng. News, Apr. 11 and 25.		
May 21.	Addition to U. S. bldg.,	Washington.	May 2
May 21.	Water-wks system,	Mount Pulaski, Ill.	May 2
	Advertised, Eng. News, May 2 and 9.		
May 21.	Paving bonds ($4,800),	Salem, O.	May 2
May 21.	Brick paving (3,076 sq. yds.),	Salem, O.	May 2
May 21.	Brick paving,	Frankfort, Ind.	May 2
	Advertised, Eng. News, May 2 and 9.		
May 21.	Brick paving (6,480 sq.yds.),	Warren, O.	May 9
May 21.	Sewers,	Buffalo, N. Y.	May 9
May 21.	Brick paving (27,000 sq. yds),	Canton, Ill.	May 9
	Advertised, Eng. News, May 9.		
May 21.	Cobblestone paving,	Brooklyn, N. Y.	May 9
May 21.	Bridges,	Sterling, Neb.	May 16
May 21.	Macadamizing,	Columbus, O.	May 16
May 21.	Bridge approach,	Ionia, Mich.	May 16
May 21.	Steel bridge,	Peoria, Ill.	May 16
May 21.	Street sweeper,	Marinette, Wis.	May 16
	Advertised, Eng. News, May 16.		
May 21.	Dredging,	New York, N. Y.	May 16
May 21.	Water extensions,	Highland Park, Ill.	May 16
May 21.	Water-works system,	Claysville, Pa.	May 16
May 21.	Cast iron pipe, etc.,	Collingwood, Ont.	May 16
May 21.	Crushed stone,	Baltimore, Md.	May 16
May 21.	Brick paving (16 contracts),	Louisville.	May 16
May 21.	Paving,	Indianapolis, Ind.	May 16
May 21.	Brick paving,	Terre Haute, Ind.	May 16
May 22.	Drill hall,	Halifax, N. S.	May 2
May 22.	Paving,	Hoboken, N. J.	May 9
May 22.	Collecting garbage, etc.,	Hoboken, N. J.	May 9
May 22.	Viaduct,	Chicago, Ill.	May 16
May 22.	Dam, etc.,	Cambridge, Mass.	May 16
May 22.	Laying water pipe,	Cleveland, O.	May 16
May 22.	Granite block paving,	New York.	May 16
May 22.	Brick paving,	Mount Vernon, N. Y.	May 16
May 22.	Macadamizing (9,000 sq.yds.),	Cleveland.	May 16
May 22.	Earth excavation,	Cambridge, Mass.	May 16
May 22.	Church,	London, Ont.	May 16
May 22.	Court house,	St. James, Minn.	May 16
May 22.	Dormitory,	Pullman, Wash.	May 16
May 22.	Rock asphalt paving,	New York, N. Y.	May 16
May 23.	Water-wks. system,	Santa Clara. Cal.	Mar. 7
	Advertised, Eng. News, Mar. 7 to 28.		
May 23.	Public building, at	New London, Ct.	May 2
May 23.	New water supply,	Schenectady, N. Y.	May 2
	Advertised, Eng. News, May 2.		
May 23.	Bridge,	Winnipeg, Man.	Apr. 18
May 23.	Plans for school building,	Buffalo, N. Y.	May 9
May 23.	Metal work,	Tompkinsville, N. Y.	May 9
	Advertised, Eng. News, May 9 and 16.		
May 24.	Excavating at	Newburg, N. Y.	May 2
May 24.	Asphalt paving,	Washington, D. C.	May 9
May 24.	Road improvements,	Glendale, R. I.	May 16
May 24.	Water tower, etc.,	West Troy, N. Y.	May 16
May 25.	Bridge substructure,	Cleveland, O.	May 9
May 25.	Water-works system,	Oak Park, Ill.	May 16
May 25.	Sewers,	Oak Park, Ill.	May 16
May 25.	Water bonds	Rockville Center, N. Y.	May 16
May 27.	Dams & shore protections,	Miss. River.	May 2
	Advertised, Eng. News, May 2 to 23.		
May 27.	Street improvements,	Evanston, O.	May 9
May 27.	Steel bridge,	Crawfordsville, Ind.	May 16
May 27.	Water-works system,	Peraskie, Pa.	May 16
	Advertised, Eng. News, May 16 and 23.		
May 27.	Sewer,	Plymouth, Ind.	May 16
May 27.	Hospital,	Binghamton, N. Y.	May 16
May 27.	Paving,	Philadelphia, Pa.	May 16
May 27.	Pumping station,	Russell, Kan.	May 16
May 28.	Jail,	Brazil, Ind.	Apr. 25
May 28.	Pier work,	New York, N. Y.	May 16
May 28.	Electric light bonds,	Wapakoneta, O.	May 16
May 28.	Pipe sewers,	Buffalo, N. Y.	May 16
May 28.	Public bldg. work at	St. Paul, Minn.	May 16
May 28.	Cobblestone paving,	Brooklyn, N. Y.	May 16
May 29.	Machine tools,	Watertown, Mass.	May 2
May 29.	Sewer,	Cleveland, O.	May 9
May 29.	Brick building,	Sherman, Tex.	May 9
May 29.	Dredging,	Tompkinsville, N. Y.	May 16
May 29.	College buildings,	St. Paul, Minn.	May 16
May 29.	Pmpg. eng. & boiler,	Buffalo, N. Y.	May 16
May 29.	Bldgs. for Braddock Point Station,	N. Y.	May 16
May 29.	Public bldg. work at	Newbern, N. C.	May 16
May 29.	Steel frame for bldg.,	Washington.	May 16
May 30.	Steel tank, pump, etc.,	Wenona, Ill.	May 16
May 31.	Pipelaying (50 miles),	Syracuse, N. Y.	May 9
	Advertised, Eng. News, May 9 and 16.		
May 31.	Water-works system,	Whitehall. Wis.	May 9
May 31.	Pipe sewers (5,000 ft),	Findlay, O.	May 9
May 31.	Cement and sand,	Portland, Me.	May 16
	Advertised, Eng. News, May 16 and 23.		
May 31.	Artesian well,	Elmwood, Ill.	May 16
May 31.	School building,	Reading, Mass.	May 16
May 31.	Pipe sewers (17½ miles),	Ann Arbor.	May 16
	Advertised, Eng. News, May 16 and 23.		
June 1.	Electric lighting,	Vancouver, B. C.	Apr. 25
June 1.	Plans for cotton factory,	Weldon, N. C.	May 9
June 1.	Steel forgings, etc.,	Washington, D. C.	May 16
June 1.	Steam road roller,	Toronto, Ont.	May 16
	Advertised, Eng. News, May 16 and 23.		
June 1.	Water-works system,	Postville, Ia.	May 16
June 1.	Brick paving,	Ashtabula, O.	May 16
June 1.	Concrete sidewalks,	Dolgeville, N. Y.	May 16
	Advertised, Eng. News, May 16 and 23.		
June 1.	Grading,	Kansas City, Mo.	May 16
June 3.	Courthouse plans,	Winfield, W. Va.	Apr. 18
June 3.	Electric lighting,	Chattanooga, Tenn.	May 16
June 3.	Water bonds College Point,	N. Y.	May 16
June 3.	Powder for Benicia Arsenal,	Cal.	May 16
June 3.	Building,	Nebraska City, Neb.	May 16
June 3.	Court house,	Natchitoches, La.	May 16
June 4.	Right to cut timber,	Toronto, Ont.	May 9
June 4.	Cast iron pipe,	Toledo, O.	May 16
June 4.	Officers' barracks,	Omaha, Neb.	May 16
June 4.	Court house,	Zebulon, Ga.	May 16
June 5.	Bridges,	Cottonwood Falls, Kan.	May 9
June 6.	Foundation for lock,	New Orleans, La.	May 16
June 6.	Granite block paving,	Cincinnati, O.	May 16
June 7.	Bridge,	Versailles, Ind.	Apr. 18
June 7.	Piers, etc.,	Detroit, Mich.	May 9
	Advertised, Eng. News, May 9 to 30.		
June 7.	Pipelaying,	Syracuse, N. Y.	May 16
	Advertised, Eng. News, May 16 and 23.		
June 7.	State house,	Providence, R. I.	May 16
June 7.	Public building,	Rock Island, Ill.	May 16
June 8.	Water-works franchise,	Alexandria, Ind.	May 16
	Advertised, Eng. News, May 16 and 23.		
June 9.	Public bldg. work at	Taunton, Mass.	May 16
June 10.	Electric light plant,	Montreal Que.	May 9
June 10.	Building,	Faribault, Minn.	May 16
June 10.	Observatory,	Columbus, O.	May 16
June 10.	Interior of court house,	Rochester, N. Y.	May 16
June 15.	Irrigation canal,	Portland, Ore.	Apr. 18
June 15.	Sinking wells,	Norfolk, Va.	May 16
	Advertised, Eng. News, May 16.		
June 15.	Water bonds,	Canandaigua, N. Y.	May 16
June 19.	Water-works system,	Pawhuska, Okla.	May 16
June 26.	Court house and jail,	Swainsboro, Ga.	May 16
June 27.	Jetty work,	Montgomery, Ala.	May 16
	Advertised, Eng. News, May 16 to June 6.		
July 3.	Bridges,	Ukiah, Cal.	Apr. 18
July 6.	Jail cells,	Auburn, Cal.	May 16
July 8.	Courthouse,	Baltimore, Md.	May 9
	Advertised, Eng. News, May 9 to 23.		
Aug. 5.	Plans for state capitol,	St. Paul, Minn.	Apr. 25
Oct. 1.	Plans for art building,	Philadelphia, Pa.	Apr. 11
No date.	Bridge,	Durham, Me.	May 16
"	Arc lights (200),	Johnstown, Pa.	May 16
"	Concrete walks (3,500 yds.),	Natick, Mass.	May 16

RAILWAYS.

East of Chicago.

ATLANTIC & LAKE SUPERIOR.—This railway was noted in our issue of May 2. The contract for building the line between Sorel and Point Lewis, 115 miles, has been awarded to W. G. Reid, of Montreal, who has already sublet the contract for the first 10 miles from Chaudiere, near Point Lewis, to Thos. Rodgers, who worked under Mr. Reid last year on the United Counties road. It is stated that the construction will soon be commenced and pushed as rapidly as possible. The work will require several large bridges, press reports stating that some of them will cost about $100,000 each. Messrs. Connolly have the contract for the eastern section of this road, terminating at Paspebac.

AU SABLE & NORTHWESTERN.—It is reported that this railway will soon be extended from Lewiston to Vienna, Mich., six miles. Gen. Man., Geo. A. Loud, Au Sable, Mich.

BALTIMORE & OHIO.—Press reports from Niles, Mich., state as follows: The Baltimore & Ohio Ry. Co. has purchased, or will soon purchase, the old St. Joseph Valley R. R., running between Buchanan and Berrien Springs. It is also announced that the company is about to close a deal by which it will come into possession of the Elkhart & Western, between Elkhart and Mishawaka, Ind. It is stated the company intends to construct a line from Milford, Kosciusko county, Ind., to Elkhart, to connect with the Elkhart & Western from Mishawaka to Buchanan, and to connect with the St. Joseph Valley road, and from Berrien Springs to Benton Harbor and St. Joseph, Mich., thus securing an entrance to the Lake Michigan port.

CHICAGO & WEST MICHIGAN.—Bids were opened May 13, according to local papers, for extending this railway six miles from Manistee county to Turtle Lake, in Benzie county, Mich. Ch. Engr., J. J. McVean; Gen. Man., C. M. Healt, both of Grand Rapids, Mich.

FITCHBURG.—Manchester, N. H., items state that Hittinger & Worcester are making surveys for the Manchester & Milford road, which is projected to give this company a direct line to that city and secure for Manchester a more direct route to the west.

FLINT & PERE MARQUETTE.—Wm. B. Sears, Ch. Engr., Saginaw E. S., Mich., writes us that no new lines are under construction except short spurs for lumbering purposes, which are graded by the lumber companies. About 70,000 cu. yds. of filling will be done, improving the alinement, but all the work will be done by the company.

HOCKING VALLEY & LAKE ERIE.—Incorporated in Ohio May 11 to purchase the right of way granted by the state two years ago to the Columbus, Hocking Valley & Athens, along the Ohio Canal, and to build a railway from Columbus to Athens; capital stock, $3,500,000; incorporators, O. S. Kelly, of Springfield, O.; Henry C. Ellison, of Cleveland; Wm. F. Kelly, C. L. Kurtz and W. H. Jennings, of Columbus.

LEHIGH VALLEY.—The award of contracts for building the extension from Honeoye Falls to Hemlock Lake, N. Y., 14 miles, was noted last week. The Rochester & Southern R. R. Co. was incorporated May 7, with a capital stock of $500,000, to build the road; directors, Elisha P. Wilbur, Robert R. Sayre, of South Bethlehem, Pa.; Charles Hartshorne, John S. Garrett, Henry S. Drinker, James F. Schaperkotter, of Philadelphia; Wilson S. Bissell, of Buffalo; Joseph W. Taylor, of Rochester, and Alexander M. Holden, of Honeoye Falls. E. P. Wilbur, Pres. Lehigh Valley, subscribed for 4,930 of the 5,000 shares.

LEWISTON, AUGUSTA & CAMDEN.—This company was incorporated in Maine to build a railway from Lewiston through Webster, Wales, Bowdoin, Litchfield, West Gardiner, Farmingdale, Gardiner, Hallowell, Augusta, Windsor, China, Somerville, Palermo, Liberty, Appleton, Washington, Union and

Hope to Camden, a distance of about 70 miles. The last legislature renewed the charter for three years, and efforts are being made to secure the construction of the road. G. E. Macomber, J. W. Chase, Elias Milliken, P. O. Vickery, M. V. B. Chase, J. W. North and W. H. Williams were among the incorporators.

PITTSBURG & EASTERN.—Philadelphia papers state that the construction of this railway from a junction with the Beech Creek road, at Mehaffey, to West Newton or a point on the McKeesport & Youghiogheny road, appears to be assured, as the announcement was made May 6 that the contract for the financing, building and equipment of the road had been awarded. Work will first be begun on the eastern section, extending from Mehaffey to Rankin Summit, a distance of 20 miles, and various contractors, in company with the engineer, are now going over the ground with a view to putting in bids for sub-contracts of that portion of the work. Awards will be made about the latter part of the month, and the work pushed forward as rapidly as possible. This section will develop the Cush Creek and Little Mahening coal fields. The next section will traverse the Loyalhanna and Pittsburg coal basins, and will also reach the Connellsville coke and the Westmoreland coal regions. It is expected to complete from 30 to 40 miles of the road by the end of the year. The entire length of the road will be 117 miles, with about 23 miles of coal branches in Indiana and Westmoreland counties. This road was noted in our issue of April 11. Ch. Engr., J. C. Patterson, Bullit Bldg., Philadelphia.

Southern.

ADDISON & PICKENS.—The locating survey is being made by C. W. Fawcett, Ch. Engr., for this railway from Pickens, Randolph county, to Addison, Webster county, W. Va., and it is stated that the construction will probably be commenced this month. Geo. M. Whitescarver, Supt. Pickens Lumber Co., is president of the company. The line is practically an extension of the West Virginia & Pittsburg, of which A. H. Kunst, of Weston, W. Va., is vice-president and general manager.

AUGUSTA SOUTHERN.—It is reported that this company will build an extension from Gibson to Louisville, Ga., 15 miles. Ch. Engr., R. T. Barksdale, Augusta, Ga.

FERNANDINA & WESTERN.—John M. Cook, Ch. Engr., Fernandina, Fla., writes us that engineers commenced locating the first division of the road, from Fernandina to Jasper, 90 miles, on May 9.

MONTGOMERY, HAYNEVILLE & CAMDEN.—It is stated that certain capitalists recently made a trip over the proposed route of this road, and that it is hoped to commence the construction at an early date. Ch. Engr., Jno. A. Milner, Birmingham, Ala.; Pres., Sol D. Bloch, Camden, Ala.

PORTERS CREEK & GAULEY.—Incorporated in West Virgina May 4 to build a railway along Elk River and Gauley River, W. Va.; capital stock, $1,000; incorporators, F. N. Koons, Trimble, O.; J. C. Gillett, Athens, O.; W. A. McCorkle, G. D. Chilton and Reginald Jackson, Charleston, W. Va.

SOUTH ALABAMA & GULF.—J. R. Crawford, Dothan, Ala., writes us that surveys are now being made and the right of way being secured for this railway, noted last week, and that contracts for the construction will soon be awarded. The capital for the construction has been secured.

TALLASSEE.—The Tallassee Mfg. Co., according to a press report, one of the largest and most substantial cotton manufacturers in the south, has an engineer corps of ten men in the field for the preliminary survey of a railway to connect its factory by rail direct with the outside world. The road will be built from Tallassee, Ala., to Sistrunk's Bridge, there crossing the Tallapoosa River, on to Tuttle's Mills, near Cross Keys, on the Western of Alabama, direct to Sledge's Station, on the Savannah, Americus & Montgomery road, giving a direct connection to Montgomery south and Savannah east.

Northwest.

LOGGING.—Superior, Wis., papers state that David Doble is hiring a large number of men to push the construction of Mr. Weyerhauser's logging railway on to Allouez Bay.

VALLEY TERMINAL.—Incorporated in Wisconsin May 8 to build a railway from Green Bay through Brown, Outagmie and Winnebago to Neenah, a distance of about 30 miles, tapping the cities of Green Bay, Kaukauna, Appleton and Neenah; capital stock, $750,000, all subscribed; directors, John J. McIntyre, of Niagara Falls, N. Y.; George E. Green, Binghamton, N. Y.; Joseph Taylor, Detroit, Mich.; A. B. Allen, Chicago; Walter Pelton and John M. Baer, of Appleton. This is the projected Fox River Valley road, recently noted. It is believed that the road will ultimately be extended to Oshkosh. The same men have organized the American Timber Co., with $500,000 capital, with headquarters at Appleton, Wis., to manufacture wood pulp and convert it into paper.

WINNIPEG & HUDSON'S BAY.—We are informed that the contract for building 250 miles of this railway, noted last week, has been awarded to Donald Grant, of Faribault, Minn.; Timothy Foley, of Foley Bros., and Guthrie, St. Paul; and James Isbister, of Ottawa. Chief Engineer Stewart and A. G. Bayne, of Winnipeg, Asst. Engr., are locating the line northwesterly from Portage la Prairie. Canadian, English and Belgian firms are reported as submitting bids for rails.

Southwest.

DENISON & NORTHERN.—The contract for building this railway from Denison, Tex., to Dougherty, Ind. T., is reported to have been awarded to McTighe & Co., of Memphis, Tenn. This project was noted in our issue of April 25.

KANSAS CITY, PITTSBURG & GULF.—Over 1,000 men are reported at work on this railway, and it is expected that the line will soon be in operation between Kansas City and Shreveport, La.

NEOSHO BELT.—Lee Bell and S. R. Patterson, of Neosho, Mo., have petitioned for a franchise for a dummy line to be called the Neosho Belt R. R.

MUSCOGEE & OKLAHOMA WESTERN.—Incorporated in Oklahoma, May 6, to build a railway from Muscogee, Ind. T., to Enid, Okla., via Cleveland, Pawnee and Perry. Capital stock, $1,000,000. W. N. Herbert, of Cleveland, one of the directors, is reported as stating that the money for building the road is all assured, and that work will begin in a few weeks. This is doubtless a reincorporation of the Muscogee, Oklahoma & Western, incorporated April 1, and noted in our issue of April 11.

PECOS VALLEY.—Press reports state that this railway will probably be extended at an early date from Roswell, N. Mex., to Washburn, Tex. Pres., J. J. Hagerman, Colorado Springs, Colo.

SPRINGFIELD, HARRISON & LITTLE ROCK.—P. L. Dougherty, Ch. Engr., Springfield, Mo., writes us that the preliminary survey has been completed for this railway between Springfield and Harrison, and that the location survey is under way, about 25 miles now being located.

UNION TERMINAL.—This company is reported as about to extend its line from Argentine to Turner Station, six miles southwest of Kansas City, Kan. The incorporation of the company was noted last week.

Rocky Mt. and Pacific.

CALVARISTA RY. & INVESTMENT CO.—Incorporated in Colorado to build a railway from Denver, Colo., to Calvarista, N. Mex., and to operate mines; capital stock, $1,000,000; incorporators, Henry Michelson, Thomas F. Dunaway, F. P. Johnson, Richard Darling, John C. Martin, Herman Brukk and Thomas B. Stewart, all of Denver; Frank Williams, of Calvarista, N. Mex., and B. S. Rodey, of Bernadillo, N. Mex.

SANTA FE & COCHITI.—Incorporated in New Mexico to build a railway from Santa Fe along the Santa Fe River to Agua Fria, and thence to Rio Grande, via Allerton and Bland; capital stock, $250,000; incorporators, A. H. Handlan, T. M. Murray, Levi Ellis, J. H. Purdy and H. Claussen.

UTAH, NEVADA & CALIFORNIA.—This company was incorporated in 1889 to build a railway from Salt Lake City to Los Angeles or San Diego, Cal. Efforts are now being made to secure the necessary capital for the construction. At the recent annual meeting the following officers were elected: Pres., Francis Tiernan; Vice-Pres., R. S. Walker, of Topeka, Kan.; Secy., John J. Stewart; Treas., E. I. Thorn. The Utah Construction Co. has the contract for the construction, as soon as the necessary funds are secured; Pres., E. R. Stewart; Secy., L. N. Colbath; Treas., S. M. Miller. Principal office of both companies, Salt Lake City.

STREET AND ELECTRIC RAILWAYS.

NORWAY, ME.—It is reported that work will soon begin on the Norway & South Paris St. Ry., which will be about two miles in length. Secy., J. F. Hill, Augusta.

PORTLAND, ME.—The Cape Elizabeth St. Ry. Co. has been incorporated to build an electric railway from Cape Elizabeth to South Portland, a distance of 22 miles; capital stock, $90,000; incorporators, James H. Boyd and Jacob S. Winslow, of Portland; Albert D. Boyd, of South Portland, and Thomas S. Krutz, of New York.

DOVER, N. H.—The Wells Beach & Ogunquit Electric R. R. Co. is about to be organized to build a road between Wells Beach and Ogunquit, a distance of seven miles. W. H. Eaton, of Wells Beach, is interested.

OSSIPEE, N. H.—The Ossipee Valley Electric Ry. Co. is preparing to build its road from Baldwin across the Ossipee River to Cornish, Slab City, Kezar Falls and Porter, in Maine, and to Effingham, Freedom and Ossipee, in New Hampshire, the road to be about 20 miles in length. Wm. D. Churchill, of Cornish, is interested.

BRATTLEBORO, VT.—C. F. Thompson, Treas., writes us that nothing has been done yet on the construction of the Brattleboro St. R. R. Co.'s road in Brattleboro, to be 3½ miles in length, but it is expected that work will commence about May 15 or 20. Pres., E. C. Crosby.

PITTSFIELD, MASS.—The Pittsfield Electric St. Ry. Co. is about to petition for permission to extend its road to Dalton. Gen. Man., P. C. Dolan.

SOMERSET, MASS.—The Dighton, Somerset & Swansea St. Ry. Co. has been incorporated to build an electric road 24 miles in length; capital stock, $60,000; incorporators, Frank S. Stevens, Joseph F. Davis, N. A. Walker, S. M. Thomas, I. L. Otis and others.

BRISTOL, CONN.—The Bristol & Plainville Tramway Co. has appointed a committee to have the power plant extended and equip it with the necessary machinery. Supt., O. F. Strunz.

NEW HAVEN, CONN.—The New Haven St. Ry. Co. has secured right of way for an extension to its electric road from the Cove House to Lighthouse Point. Gen. Man., G. A. W. Dodge.

BALLSTON SPA, N. Y.—Mott & Son, of Saratoga Springs, are making surveys for the Ballston Electric R. R. Co.

NEW YORK, N. Y.—The Columbus & Ninth Ave. R. R. Co. has filed a certificate of extension of its road from 96th St. and Columbus Ave. to Central Park West.

PATCHOGUE, N. Y.—The Patchogue & Port Jefferson Traction Co. has been organized to build an electric railway from Port Jefferson through Selden and Medford to Patchogue. Orange T. Fanning, of Port Jefferson, Joseph B. Swezey and Wilson Ritch, of Patchogue, are interested.

SAND LAKE, N. Y.—It is reported that an electric railway is to be built between this place and Albia, estimated to cost $150,000. William Shaw, James K. Averill and Edward F. Murray are interested.

SYRACUSE, N. Y.—The Syracuse & East Side Ry. Co. has petitioned for permission to extend its electric road. Gen. Man., C. D. Beebe.

WATKINS, N. Y.—The Watkins & Havana Electric R. R. Co. has been incorporated to build a road five miles in length; capital stock, $50,000; directors, C. S. Frost, of Watkins; C. H. Baldwin, O. M. Wixon, of Elmira; H. J. Weller, of Horseheads.

NEW BRUNSWICK, N. J.—A Newark syndicate has purchased the street railway and will at once equip it with electricity, and extend it to Bound Brook, Milltown and South River, and later to South Amboy. Pres., Gottfried Kreuger; Vice-Pres., John Radel; Secy. and Treas., Edward Radel.

HARRISBURG, PA.—The Citizens' Passenger Ry. Co. and the East Harrisburg Passenger Ry. Co. have consolidated under the name of the Harrisburg Traction Co.; capital stock, $1,500,000. It is reported that a number of improvements will be made.

PITTSBURG, PA.—The McKeesport & West Newton Passenger Ry. Co. has been incorporated to build a street railway from Boston to West Newton by way of Buena Vista, Industry and Douglass; capital stock, $60,000; Pres., W. C. Jutte; Director, Elliott Rogers, Pittsburg.

WEST NEWTON, PA.—It is reported that the Versailles Electric St. Ry. Co. will extend its road from Boston to Buena Vista, Scott Haven and West Newton, which will make the road 15 miles in length.

ROCKVILLE, MD.—The Tacoma, Burnt Mills & Sandy Springs Ry. Co. has been incorporated to build an electric road from the line of the District of Columbia, through Prince George county to Ellicott City, by way of Sandy Springs; capital stock, $100,000; incorporators, J. B. Colegrove, M. F. Sliney and F. Ray Keys.

ELYRIA, O.—It is reported that Thomas L. Johnson is about to build an electric railway between his steel plant at this place and Cleveland, a distance of about 25 miles.

PAINESVILLE, O.—The Cleveland & Painesville Electric Ry. Co. has been granted a franchise for its road from this place to the Cuyahoga county line, a distance of about 17 miles. Pres., Gen. J. S. Casement.

SHELBY, O.—The Shelby Electric Ry. Co. has been incorporated to build a road from Annapolis to Shelby and Olivesburg; capital stock, $10,000; incorporators, S. S. Bloom, Albert Moore, G. D. Gelleien, C. S. Holbrook and F. A. Abbott.

TIFFIN, O.—The Inter Urban Rapid Transit Co. has been incorporated to build an electric railway between Tiffin and Fostoria; capital stock, $250,000; incorporators, Meskeeh Frost, Amandus Betts, Norman M. Carty and W. F. Noble.

SHELBYVILLE, IND.—The Batesville & Oldenburg Steam & Electric Ry. Co. has been organized to build a road 3½ miles in length, and later to Osgood and Versailles, a distance of 20 miles. It is proposed to build from Oldenburg to Brookville, making the entire road 40 miles in length; capital stock, $100,000; R. S. Sutton, K. M. Hord and Jonas Joseph, of Shelbyville; John Hillenbrand, of Batesville, and A. A. Hackman, of Oldenburg, are interested.

JACKSON, MICH.—John B. Colriss, of Detroit, has been granted a franchise for an electric road from Jackson to Vandercook Lake, according to reports.

ALTON, ILL.—The question of equipping the street railways with electricity is being considered. Wm. E. Smith is interested.

HOOPESTON, ILL.—The Hoopeston Electric Ry. Co. has been organized to build a road to Gilman, Sheldon, Champaign, Ill., and to Indiana Mineral Springs, Ind. John L. Hamilton, Jr., James H. Dyer, M. R. Clark, James A. Cunningham and A. H. Trego are interested.

PEKIN, ILL.—Leander King has made surveys and plans for the Peoria & Pekin Electric Ry. from Pekin through South Peoria to Peoria, a distance of about 10 miles, estimated to cost $100,000. A bridge will have to be built across the Illinois River at Pekin.

MILWAUKEE, WIS.—The Milwaukee & Waukesha Ry. Co. is being organized to purchase the Milwaukee & Wauwatosa Motor Ry.; capital stock, $1,000,000.

BURLINGTON, IA.—The Burlington Electric Ry. Co. has been granted permission to extend its road on Forest and South Main Sts.

KANSAS CITY, KAN.—The Kansas City & Northern Ry. Co. has petitioned for a franchise for its road through the city.

DE SOTO, MO.—The court of Jefferson county has granted a franchise to St. Louis parties for an electric railway from St. Louis to Morse's Mills.

KANSAS CITY, MO.—The construction of an electric railway from the end of the 15th St. cable road to Evanston is being considered. The following were appointed as a committee to confer with the Kansas City Ry. Co.: Stephen P. Twiss, Frank Hardesty, P. J. Henn, Edward H. Stiles, 514 Massachusetts Bldg., and others.

TACOMA, WASH.—The City Park Ry. Co. has been incorporated to build an electric railway; capital stock, $25,000; incorporators, E. J. Mitchell, C. N. Higgins and J. A. Cranston. The main office will be in Portland, Ore.

NAPA, CAL.—It is reported that W. C. McGeorge will petition the supervisors for a franchise for an electric road to Calistoga, estimated to cost $250,000.

NIAGARA FALLS, ONT.—The Niagara Falls Electric St. Ry. Co., Limited, has been incorporated by Alexander Manning, Charles Black, Zebulun A. Lash and Hume Blake.——The Niagara Falls, Wesley Park & Clifton Tramway Co. has petitioned for permission to change its motive power to electricity. Supt., C. Black.

QUEBEC, QUE.—H. J. Beemer has petitioned the road committee for a franchise for an electric railway.

ELECTRIC LIGHT AND POWER.

ARLINGTON, MASS.—A town meeting was held May 13 to vote on the question of establishing an electric light plant.

PHELPS, N. Y.—Bids are asked until May 20 for lighting the streets with electricity for five years. J. T. Watkins, Village Clk.

JOHNSTOWN, PA.—Bids are asked for about 200 arc lights for three or five years. John J. Brown, Cy. Controller.

SCOTTDALE, PA.—Bids are asked until May 20 for furnishing arc and incandescent lights for five years, as stated in our advertising columns. E. L. Rutherford, Secy.

WASHINGTON, PA.—It is reported that Amos E. Townsend, of Pittsburg, Pres. Washington Electric St. Ry. Co., is considering the question of applying for permission to furnish electric lights.

BALTIMORE, MD.—It is reported that the Maryland Electric Co. will soon erect a new electric light and power plant on West Pratt St., which will include a boiler house 67 × 85 ft. and a machine shop 77 × 95 ft. The boiler house will contain six batteries of boilers of 500 HP. each. The iron trusses of the roofs

of the buildings will be fitted with tracks, to serve the purpose of cranes in handling heavy materials. The machine shop will contain several new engines and a number of dynamos of the latest design.

HAGERSTOWN, MD.—Powell Evans, of Philadelphia, has been granted a franchise to transmit power to this city from the Potomac River.

SUMMERVILLE, S. C.—F. W. Wagener has made a proposition to put in an electric light plant.

MERIDIAN, MISS.—S. H. Gehlman, of Springfield, Ill., and L. B. Bradley, of Peoria, Ill., have been awarded the contract for an electric light plant of 75 arc lights, and for constructing the electric railway.

CHATTANOOGA, TENN.—Bids are asked until June 3 for erecting an electric light plant with 300 arc and 250 incandescent lights, and for supplying 175 to 250 arc and 100 incandescent lights from one to ten years. J. O. Martin, Chn. Com.

WAPAKONETA, O.—Bids are asked until May 28 for the purchase of $5,000 of 5% electric light bonds. Joseph Myers, Village Clk.

SHELBY, MICH.—It is reported that the city will put in an electric light plant this summer.

CHENOA, ILL.—The Chenoa Electric Light & Power Co. has been granted a franchise. Noah H. Pike, W. H. Bennett and W. L. Miller are interested.

CHICAGO, ILL.—The Standard Electric Co. has increased its capital stock from $1,000,000 to $1,500,000 to provide increased facilities; Pres., A. G. Spalding; Gen. Man., D. P. Perry.

MUSCATINE, IA.—The Muscatine Electric Ry. Co. has authorized Paul Seevers, Supt., to secure plans for enlarging the lighting plant, estimated to cost $60,000.

MINNEAPOLIS, MINN.—The following bids have been received for three engines to supply electric dynamos:

Ames Iron Works, Oswego, N. Y.	$5,700
Stearns Mfg. Co., Erie, Pa.	5,005
Ball Engine Co., Erie, Pa.	5,727
" " " " "	5,941
Enterprise Mach. Co., for Russell eng., Massillon.	5,565
A. L. Ide & Co., Springfield, Ill.	7,200
Link Belt Supply Co., Minneapolis.	6,900
" " " " "	8,310

GLENWOOD, MINN.—J. R. Serrin, of the Glenwood Roller Mills, has been granted a franchise to light this place by electricity.

ST. CLOUD, MINN.—The construction of a new electric light plant is being considered.

CRYSTAL, N. DAK.—It is reported that J. S. Richardson is negotiating with the citizens in regard to putting in an electric light plant.

NEW COMPANIES.—Chicago Heights Electric Co., Chicago Heights, Ill.; $50,000; W. G. Caldwell, J. H. McFaldowine, J. A. Caskey.

Citizens' Electric Light, Heat & Power Co., Reading, Pa.; $100,000; Pres., John R. Bechtel; Secy., Chas. N. Frome; Treas., Henry C. England.

San Mateo Electric Light Co., San Mateo, Cal.; $25,000, with $15,875 paid in; F. M. Greenwood, F. A. Greenwood, San Francisco; Phil M. Roedel, Alfred B. Ford, C. E. Knapp, San Mateo.

Montclair Light & Power Co., Montclair, N. J.; $50,000, with $10,000 paid in; Geo. F. Baker, Chas. C. Poe, New York; W. G. Snow, Chas. D. Backus, Wm. W. Ames, Montclair.

BRIDGES.

HOLLIS, ME.—The selectmen have awarded a contract to the Boston Bridge Co. for rebuilding a steel bridge at Moderation at $6,200.

DURHAM, ME.—Bids are asked for building the Lisbon Falls bridge from Durham to Lisbon Falls. Geo. E. Warren, Town Clk.

HOULTON, ME.—The Berlin Iron Bridge Co. has been awarded the contract for building a $10,000 bridge across the Meduxneheag River, below the present one.

PORTLAND, ME.—It is reported that the Portland & Rumford Falls Ry. Co. is to build three iron bridges estimated to cost $12,000.

MIDDLETOWN, CONN.—The Middletown & Portland Bridge Co. is making surveys for the approaches to its bridge, work on which will soon be commenced, according to reports.

NORWICH, CONN.—C. D. Smith and others have petitioned for an iron bridge across the Yantic River at Indian Leap, estimated to cost about $4,000.

BROOKLYN, N. Y.—It is expected that the supervisors of Kings and Queen counties will soon build a bridge over Newtown Creek at Maspeth Ave.

BUFFALO, N. Y.—The governor has signed a bill appropriating $31,250 toward the construction of a canal bridge at Porter Ave., the cost to be divided equally between the state and city.

GENEVA, N. Y.—The town board has adopted a resolution appropriating $4,000 for an arch bridge over Castle Creek at Main St.

LONG ISLAND CITY, N. Y.—Press reports state that the secretary of war has approved plans for a new bridge to be constructed over Newtown Creek, between Vernon Ave., Long Island City, and Manhattan Ave., Brooklyn. The proposed bridge is to replace the present structure at that place, which has become an obstruction to the free navigation of the creek. Plans for a temporary bridge to be built near the avenues have also been approved. The temporary structure will be for the use of land travel pending the construction of the new bridge. The new bridge will be of the most improved pattern and have a lift draw, such as is in use in Chicago.

ROCHESTER, N. Y.—The city surveyor is preparing plans for a new bridge at Exchange St., over the canal, for which an appropriation of $25,000 was recently made by the legislature.

ROME, N. Y.—It is proposed to construct a swing bridge over the Black River Canal at Garden St., estimated to cost $7,000, the state to pay one-half. W. J. P. Kingsley, Mayor.

ROSENDALE, N. Y.—The Wallkill Valley R. R. Co. is reported as preparing to build a new bridge about 1,000 ft. in length, at this place, consisting of four 150 ft., two 100 ft., one 75 ft. and one 65 ft. pin-connected spans.

ASBURY PARK, N. J.—The committee has recommended that the board of freeholders paint and repair the Oceanic and Hubbard bridges at an estimated cost of $2,500 to $4,000.——The board of freeholders has voted not to construct a new bridge over Deal Lake, but will repair the present structure.

CAPE MAY, N. J.—A resolution is being considered by the board of freeholders appropriating $6,000 for a bridge to connect Five Mile Beach with the mainland.

NEW BRUNSWICK, N. J.—The United States government has issued an injunction restraining the Pennsylvania R. R. Co. from building a continuous bridge across the Delaware & Raritan Canal.

RAHWAY, N. J.—The construction of a bridge across the river from Hazelwood Ave. to East Side Park is being discussed.

ALLENWOOD, PA.—A bill is before the legislature authorizing the construction of a bridge at this place.

EASTON, PA.—Henry Scott, of the Standard Construction Co., has been appointed engineer to superintend the construction of the addition to the stone bridge about to be repaired in Lower Saucon township over Saucon Creek.

FREEMANSBURG, PA.—Wm. B. Fritchman is interested in a project to construct an iron bridge from Main and Monroe Sts. to the east side of the Lehigh River.

HARLEYSVILLE, PA.—Local papers state that the county commissioners have advertised for bids for the ironwork and masonry of five bridges to be erected in this county, located as follows: One over the Perkiomen Creek, at Schwenksville; one over Park Creek, Horsham township; one over Swamp Creek, New Hanover township; one over the Wissahickon Creek, Whitemarsh township, and one over the west branch of the Perkiomen Creek, Douglass township.

KENSINGTON, PA.—Press reports state that it is proposed by Driver & Ranson, of Pittsburg, to build an iron bridge across the Allegheny River, between New Kensington and Tarentum. They have asked the citizens of those places to provide a charter for the same and an effort is being made to do so. A street railway company and the Burrell Improvement Co. each has a bridge charter, and one or the other will be utilized.

PHILADELPHIA, PA.—It is reported that efforts are being made to induce the Pennsylvania R. R. Co. to co-operate with the city in the construction of a new steel bridge over the Schuylkill River, taking the place of the wooden one at Gray's Ferry, estimated to cost $300,000 to $500,000.

McKEESPORT, PA.—The Mifflin Bridge Co. has been incorporated to build a bridge over the Monongahela River between McKeesport and Mifflin township; capital stock, $5,000, with $500 paid in; Treas., John F. Davitt, McKeesport.——The McKeesport Bridge Co. has been incorporated to build a bridge from Market St., McKeesport, to Mifflin; capital stock, $1,000; Treas., E. K. Morse, 1206 Carnegie Bldg., Pittsburg.

PITTSBURG, PA.—The Sharpsburg & Lawrenceville Bridge Co. has voted to increase its capital stock from $80,000 to $200,000, to erect as soon as possible a new bridge from 45th St. to Sharpsburg. The bridge will be 2,000 ft. in length, and 40 ft. in width. Pres., Geo. A. Chalfant.

READING, PA.—Press reports state that a steam dredge loaded upon a gondola car, while being shifted on the Reading R. R. May 6, caught as it passed under the Walnut St. bridge, breaking a number of the beams of the bridge, and injuring the floor so much that the bridge will probably have to be rebuilt.

PLYMOUTH, PA.—The county commissioners will build a bridge across the Wissahickon River on the road from the Skippack pike to the Morris Road, according to reports.

WASHINGTON, PA.—E. C. Curry, J. S. Kerr, and M. M. Bryant, have recommended the construction of a bridge over Mingo Creek, and another over Sugar Run.

WILMINGTON, DEL.—Press reports state that the plans for the viaduct to cross the Philadelphia, Wilmington & Baltimore R. R. tracks at Fourth St. comprise a 102-ft. clear span across the tracks, with approaches 530 and 380 ft., respectively, supported by iron columns for 180 ft., and the rest by embankment with retaining walls. D. W. Taylor, W. D. Mullin, Jr., A. D. Warner and John S. Rossell have been appointed a committee to examine the plans.

CATONSVILLE, MD.—Samuel Martin, Oliver Knodle, of Leitersburg, and others have petitioned the county commissioners to build a bridge across the Antietam at Fox's Ford. Geo. C. Snyder, Pres. Bd. Comrs.

NORFOLK, VA.—The construction of a free bridge from Main St., Norfolk, to Main St., Berkley, is being considered.

DEMOPOLIS, ALA.—It is reported that an old bridge over the canal at the edge of the town gave way May 6.

NEW ORLEANS, LA.—It is reported that work will soon begin on the construction of the steel bridge across the Mississippi River at this place, to be built by the Southern Pacific Co.

LOUISVILLE, KY.—Bids are asked until May 17 for constructing a steel or iron bridge across Chenoweth Run, near the poorhouse, Jefferson county. Hart Vance, County Surv.

ASHTABULA, O.—H. E. Mann, Cy. Engr., writes us that the city voted April 1 to issue $25,000 in bonds to aid the county commissioners in building a high bridge at Spring St. The bridge will be built under the supervision of the county commissioners. Address Thos. McGovern, Geneva.

IRONTON, O.—Geo. H. Davis, Cy. Clk., writes us that bids will soon be asked for the erection of an iron bridge, noted in our issue of last week. J. R. C. Brown, Cy. Engr.

MARIETTA, O.—Plans have been prepared for a bridge over the Ohio River, and the council has been petitioned to grant a franchise.

CRAWFORDSVILLE, IND.—Bids are asked until May 27 for constructing one 60-ft. span steel bridge. J. D. Tracy, Cy. Clk.

HOUGHTON, MICH.—Press reports state that the county board rejected all bids for the new steel bridge over Portage Lake. The King Bridge Co., of Cleveland, reduced its bid $6,000 and secured the contract for $52,000, the bridge to be completed Aug. 15.

IONIA, MICH.—Bids are asked by the city clerk until May 21 for building a 50-ft. approach span to the upper Grand River bridge.

CHICAGO, ILL.—Bids are asked until May 22 for building a viaduct over the tracks of the Pittsburg, Fort Wayne & Chicago Ry. at Van Buren St. W. D. Kent, Comr. Pub. Wks.

LA SALLE, ILL.—The council has voted to advertise for bids for a new arch bridge.

PEORIA, ILL.—Bids are asked by the commissioners of highways until May 21 for building a steel bridge over La Marsh Creek in Hollis, Peoria county.

DES MOINES, IA.—Frank Pelton, Cy. Engr., writes us that the Geo. E. King Bridge Co. has been awarded the contract for constructing a 100-ft. span iron bridge. The substructure is completed, and the iron for the superstructure is on the ground.

AITKIN, MINN.—The county commissioners have called an election to be held June 11 to vote on the question of issuing $16,000 in bonds for roads and a bridge across the Mississippi River at this place.

STERLING, NEB.—Bids are asked until May 21 for constructing such iron and wooden bridges as may be required during the year in Johnson county. Wm. A. Campbell, County Clk.

KANSAS CITY, MO.—The Missouri Pacific Ry. Co. has decided to rebuild the bridge over its tracks at Lynn St.

FLORENCE, COLO.—It is reported that the Howe truss bridge, eight miles north of this place on the Florence & Cripple Creek R. R. across Eight-Mile Creek, was burned May 7. The bridge cost about $40,000.

MONTREAL, QUE.—Several large bridges will be required on an extension of the Atlantic & Lake Superior Ry., as noted under Railways.

BUILDINGS.

BOSTON, MASS.—It is reported that the commissioners have asked for an appropriation of $300,000 to complete the building of the extension to the state house. The original appropriation of $2,500,000 is exhausted, it is said, with the exception of $90,000, and about $400,000 will be needed to construct the building which is to connect the Bulfinch front with the extension.

FALL RIVER, MASS.—The Parker Mfg. Co. has been organized to erect a 40,000-spindle mill; capital stock, $400,000; Clk., Milton Reed; Treas., Seth A. Borden; directors, Leontine Lincoln, James E. Osborn and J. B. Flint.——It is reported that the Fall River Iron Works Co. is to build a 75,000-spindle print cloth mill here this summer. M. C. D. Borden, of New York, is the owner.

GAY HEAD, MASS.—The following bids were received by S. I. Kimball, Gen. Supt. U. S. Lifesaving Service, Washington, May 3, for constructing a lifesaving station, etc., at this place, as advertised in Engineering News:

Frank B. Sistare, New Bedford, Mass.	$6,775
A. F. Blossom, Fair Haven, Mass.	6,636
A. J. Servis & Son, Youngstown, N. Y.	5,577
W. H. Glover Co., Rockland, Me.	6,675
Arthur J. Brennan, Mattapan, Mass.	5,450
Geo. E. Gill, Reading, Mass.	7,979
Henry A. Tolbert, Barnegat, N. J.	9,400
Richardson & Burgess, Washington, D. C.	5,800
Z. B. Davis, South Dartmouth, Mass.	6,916
I. H. Hathaway & Co., Philadelphia, Pa.	7,150
A. R. Taylor, Norfolk, Va.	7,482

READING, MASS.—Bids are asked until May 31 for constructing a 10-room school building. Address Mr. Fuller, Room 215, 23 Court St., Boston. Gilman L. Parker, Secy.

WRENTHAM, MASS.—Bids are asked until May 20 for the erection of a town and school building at Wrentham Center. Arch., Daniel H. Woodbury, 120 Tremont St., Boston; Wm. M. Proctor, Chn. Bldg. Com.

PROVIDENCE, R. I.—Bids are asked until June 7 for building a new state house. Archs., McKim, Mead & White, 160 Fifth Ave., New York; E. K. Glezen, Secy. Bd. State House Comrs., Industrial Trust Bldg.

WATERBURY, CONN.—W. H. Allen, of New Haven, has prepared plans for a new brick county court house, 60 × 80 ft., estimated to cost $55,000.

BINGHAMTON, N. Y.—Bids are asked until May 27 for the construction of the city hospital. Lewis Seymour, Cy. Clk.

BINGHAMTON, N. Y.—An election will be held May 28 to vote on the question of building a new city hall, estimated to cost $125,000, and a new fire station, estimated to cost $25,000, including the site for the latter. Lewis Seymour, Cy. Clk.

BROOKLYN, N. Y.—It is reported that a 10-story building will be erected on Montague St. for the Fulton Bank. John A. Nexsen, Cashier.

NEW YORK, N. Y.—Columbia College has received a gift from President Seth Low of $1,000,000 for a new library building at 116th St., on Morningside Heights, and from Wm. C. Schermerhorn, Chn. Bd. Trustees, of $300,000 for a college building.——The city has filed plans for a six-story brick school building on Henry St., between Catharine and Oliver Sts., to cost $200,000.——L. F. Entzer, 78 East 96th St., has prepared plans for a 12-story brick and stone apartment house for Lambert Suydam, 163 Broadway, to cost $350,000.

ROCHESTER, N. Y.—Bids are asked until June 10 for finishing the interior of the new court house. Arch., J. F. Warner, Granite Bldg.; L. M. Otis, Chn. Bldg. Com.

PATERSON, N. J.—Henry P. Wynne, of Passaic, has prepared plans for enlarging the county court house.

LATROBE, PA.—It is reported that a theatre, estimated to cost $100,000, will be erected at St. Vincent's Abbey.

PHILADELPHIA, PA.—It is reported that plans have been prepared for a seven-story stone addition to the Hotel Albion on Chestnut St., estimated to cost $500,000.——Allen B. Rorke has been awarded a contract for fitting up the prothonotary's office and toilet

rooms on the second and third floors of the city hall, at $137,100.

BALTIMORE, MD.—Wyatt & Nolting have prepared plans for an apartment house at Cathedral St. and Mount Vernon Place, estimated to cost $150,000. J. B. Chastain, acting for the owners, Henry White and J. L. White, has applied for a building permit.

BALTIMORE, MD.—The Campbell-Zell Co. has prepared plans and will soon award the contract for building new shops, 265 × 40 ft., a power house 40 × 40 ft., and a boiler shop 200 × 80 ft. A traveling crane and other machinery will be put in, according to reports.

WASHINGTON, D. C.—Bids are asked by Wm. Martin Aiken, Supervising Arch., for public building work, as follows: Until May 28 for third story columns and fourth floor beams and girders, etc., at St. Paul, Minn.; May 29, piling foundations, at Newbern, N. C.; June 7, erection and completion, except heating apparatus, at Rock Island, Ill.; June 9, excavation, foundations, floors, ceilings, roof covering, approaches, etc., at Taunton, Mass.—Bids are asked until May 29 for erecting a steel frame for a building for the Government Printing Office, requiring about 450 tons of steel. Col. John M. Wilson, U. S. Engr., Public Bldgs. and Grounds.

ATLANTA, GA.—Bids are asked until May 20 for erecting the building for the Chinese Village at Piedmont Park. Arch., G. L. Norsman, 845 Equitable Bldg.

SWAINSBORO, GA.—Bids are asked until June 26, according to reports, for the erection of a court house and jail. Judge G. S. Roundtree, Chn. Comrs.

ZEBULON, GA.—Bids are asked until June 4 for erecting a court house for Pike county. Archs., Golucke & Stewart, Altanta; J. T. Cadenhead, Chn. County Comrs.

NATCHITOCHES, LA.—Bids are asked until June 3 for building a new court house. Archs., Favrot & Livaudais, 806 Gravier St., New Orleans; J. C. Trichel, Pres. Police Jury.

NEW ORLEANS, LA.—Maj. Jas. B. Quinn, U. S. Lighthouse Engr., received the following bids on May 1 for the metalwork and also for erecting the buildings for the Brazos River light station, as advertised in Engineering News:

Metal Work.

Gillette-Herzog Co., Minneapolis (informal)..	$7,000
Ryan-McDonald Co., Baltimore (accepted).....	9,775
The Russel Wheel & Foundry Co.....	9,880
The Tacony Iron & Metal Co., Philadelphia....	9,995
John P. McGuire, Cleveland, O.....	10,568
Allentown Rolling Mach. Works Co., Lebanon.	11,462
Chamblin, Delany & Scott, Richmond, Va.....	12,000

Buildings.

Andre Foundry, New Orleans, La. (accepted)...	$11,006
W. P. Allen, New Orleans, La.....	11,350
J. B. Camors & Co., New Orleans, La.....	14,374
Louis C. Le Corgne, New Orleans, La.....	14,460
Gude & Walker, Atlanta, Ga.....	16,000
Mock & Petry, New Orleans, La.....	18,500
Andrew Bros., St. Louis.....	21,320

CLEVELAND, O.—Bids are asked until May 29 for constructing buildings for Braddock Point light station, N. Y. Lieut.-Col. Jared A. Smith, U. S. Engrs.—The Cleveland Erecting Co. has been incorporated to erect buildings, bridges and all kinds of structural work; capital stock, $10,000; incorporators, C. E. Manary, R. L. Henry and M. H. McKenna.

COLUMBUS, O.—Bids are asked until June 10 for constructing an astronomical observatory at the Ohio State University. Alexis Cope, Secy.

ROCHESTER, IND.—It is reported that Gordon E. Gibson, of Logansport, has been awarded the contract for erecting the new court house at $78,073.

CHICAGO, ILL.—A permit has been granted to the Lewis Institute for the erection of a five-story brick store and school building at 770 to 784 West Madison St., to cost $220,000.

RACINE, WIS.—O. Burlingame, Cy. Engr., writes us that it is proposed to erect a high school building, estimated to cost $55,000; a ward school building, to cost $16,000, and a fire engine house, to cost $5,000.

FARIBAULT, MINN.—Bids are asked until June 10 for constructing a building on the grounds of the state school for the blind. Arch., E. P. Bassford, Gilfillan Block, St. Paul; R. A. Mott, Secy.

ST. JAMES, MINN.—Bids are asked until May 22 for erecting a two-story brick and stone court house for Watonwan county. Arch., H. C. Gerlach, Mankato; Theo. Sonstely, Clk. County Bd.

ST. PAUL, MINN.—Bids are asked until May 29 for erecting several buildings for the University of Minnesota. John S. Pillsbury, Pres. Bd. of Regents.

HELENA, MONT.—John C. Paulsen, of this city, has been engaged as architect and superintendent of construction for the agricultural college at Bozeman, the deaf and dumb asylum at Boulder and the state normal school at Dillon. E. A. Steere, Supt. State Bd. Education.

OMAHA, NEB.—Bids are asked until June 4 for constructing four double sets of officers' barracks at Fort Crook. Maj. Chas. F. Humphrey, U. S. Q. M.

NEBRASKA CITY, NEB.—Bids are asked until June 3 for erecting a wing to the institution for the blind. Archs., Fisher & Lawrie, Omaha; W. L. Wilson, Pres. Nebraska City National Bank.

ST. LOUIS, MO.—The Masons of the city are considering the question of purchasing the old Masonic Temple at Seventh and Market Sts., from Wm. B. Thompson, and reconstructing it at an estimated cost of $150,000. Arch., Isaac H. Taylor.

DENTON, TEX.—The commissioners' court of Denton county has voted to build a new court house, and has made an appropriation for the court to inspect the court houses in other cities.

PULLMAN, WASH.—Bids are asked until May 22 for erecting a girls' dormitory at the state agricultural college. Archs., Stephen & Josenhaus, Pioneer Bldg., Seattle; E. A. Bryan, Secy. Bd. Regents.

AUBURN, CAL.—Bids are asked until July 6 for constructing 12 cells for the new jail for Placer county. J. S. Mariner, Chn. Bd. Supervisors.

LONDON, ONT.—Bids are asked until May 22 for erecting a church building for the Queen's Ave. Methodist Church, at Dufferin Ave. and Wellington St. Archs., Burke & Horwood, 28 Toronto St., Toronto; A. B. Powell, Secy. Trustee Bd.

MONTEREY, MEX.—It is reported that the Mexican National R. R. Co. will remove its shops from Laredo, Tex., to this city, the work of removal to begin in a few weeks. The shops were built a few years ago at a reported cost of $500,000.

WATER-WORKS.

HALLOWELL, ME.—D. K. Jewell, Cy. Clk., writes us that nothing has been done for works except to purchase a water privilege seven miles from the city; population, 3,500. Ben Tenney is the official in charge.

YARMOUTH, ME.—The town has voted to purchase the charter of the Yarmouth Water Co., and to construct works to cost $40,000.

BELLOWS FALLS, VT.—The contract for pipe for the proposed new main has been awarded to R. D. Wood & Co.

CAMBRIDGE, MASS.—Bids are asked until May 22 for constructing a dam and appurtenances in the town of Lincoln. L. M. Hastings, Cy. Engr.

LOWELL, MASS.—The water board has voted to make extensions in eight streets.

MILLBURY, MASS.—The Worcester Engineering Co. has contracted with Gould's Mfg. Co., of Seneca Falls, N. Y., for a 1,000,000-gallon pumping engine for the Millbury Water Co.

ALBANY, N. Y.—Bids are asked until May 20 for laying mains in 13 streets; also for hauling 850 gross tons of pipe. Geo. I. Bailey, Supt.

BOONVILLE, N. Y.—A local paper states that the board of trustees is unanimously in favor of constructing works.

BUFFALO, N. Y.—Bids are asked until May 29 for a 30,000,000-gallon pumping engine and four-cylinder boilers. R. G. Parsons, Secy. Dept. Pub. Wks.

CANANDAIGUA, N. Y.—Bids are asked until June 15 for the purchase of $130,000 in 4% water bonds. Chas. F. Robertson, Pres. Comrs.

CAPE VINCENT, N. Y.—An election will be held May 28 to vote on an issue of $25,000 in bonds for constructing works. L. T. Kelsey, J. A. Scobell and S. M. Pease, Comrs.

CHARLOTTE, N. Y.—The village board is considering the appointment of water commissioners to investigate the question of works, Frank Vance is interested.

COHOES, N. Y.—The superintendent has been directed to purchase a new pump.

COLD SPRING, N. Y.—At a special election last week the village voted to construct works, to cost $30,000. I. P. Malboy is interested.

COLLEGE POINT, N. Y.—Bids are asked until June 3 for the purchase of $11,000 in 4% water bonds. It was voted in February to build an $18,000 water tower. F. R. Clair, Village Treas.

GREENWICH, N. Y.—The water company is reported to have selected a site for a new reservoir.

MONTICELLO, N. Y.—John A. Miller, Goshen, is preparing plans for works, for which it is expected that bids will soon be asked.

NEW ROCHELLE, N. Y.—The New Rochelle Water Co. is reported as surveying the streets of Bronxville and Tuckahoe preparatory to furnishing these villages with water.

PHELPS, N. Y.—A committee has been appointed to consider the advisability of issuing $30,000 in bonds for works and an electric light plant. E. D. Meade and H. W. Edson are interested.

POUGHKEEPSIE, N. Y.—The commissioners are reported to have decided to have a shed built over the filter beds at the pumping station, at a cost of $10,000.

ROCKVILLE CENTER, N. Y.—Bids are asked by the water board until May 25 for the purchase of $29,500 in 5% water bonds.

SPRINGVILLE, N. Y.—The citizens have voted, 116 to 7, in favor of the purchasing of works.

SYRACUSE, N. Y.—Bids are asked until June 7 for trenching and pipelaying, as stated in our advertising columns. W. R. Hill, Ch. Engr.; J. B. Brooks, Secy.

WARSAW, N. Y.—It is stated that another election will soon be held to vote on the question of issuing bonds for works, as the previous election was illegal.

WHITE PLAINS, N. Y.—The water supply committee has organized, and is negotiating with engineers for plans for works estimated to cost about $80,000, according to reports. Chn., E. B. Long; Clk., Christopher Harmon.

WEST TROY, N. Y.—Bids are asked until May 24 for constructing water-tower, filters, etc., and laying water mains, at Watervliet Arsenal. Maj. Isaac Arnold, Jr., Ord. Dept.

CAMDEN, N. J.—The board of trade has recommended a supply from artesian wells.

HIGHSTOWN, N. J.—At an election May 6 the citizens voted to issue $20,000 in bonds for works, only 28 votes out of 341 being against the proposition. A committee will be appointed at once, and the contracts awarded as soon as possible. Fred B. Appleget, Clk.

JERSEY CITY, N. J.—The board of finance did not concur in the award of the contract for a water supply, and it is probable that new bids will soon be asked upon specifications which will permit of more extensive competition.

TRENTON, N. J.—It is reported that contracts aggregating about $20,000 have been awarded for enlarging and altering the pumping station at the foot of Calhoun St. John V. Schedeker has the contract for the mason work, Wm. Mills that for the carpenter work and the New Jersey Steel & Iron Co. that for the iron work.

OLAYSVILLE, PA.—Bids are asked by the borough council until May 21 for constructing works, according to reports.

DRIFTWOOD, PA.—C. F. Laughton, Secy. Council, writes us that nothing definite has yet been decided in regard to works, though it is probable that a company will put in a plant.

HELLERTOWN, PA.—The council is taking steps to secure works. A. P. Folwell, of Potter & Folwell, has stated that a supply can be secured from springs or an artesian well.

HOMESTEAD, PA.—The contract for a pumping engine has been awarded to Henry R. Worthington at about $9,000. Arrangements are being made for extensions.

MACUNGIE, PA.—The contract for works is reported to have been awarded to O'Reilly & Noland, of Reading, who have recently constructed works at East Greenville. Engr., L. J. H. Grossart, Allentown, Pa.

MEADVILLE, PA.—The injunction restraining the city from issuing bonds for constructing new works has been dissolved, and the contract for works has been awarded to Chandley Bros. & Co., of Beaver Falls, at $105,725, the works to be completed within six months.

PERKASIE, PA.—Bids are asked until May 27 for constructing works, as stated in our advertising columns. Engrs., Potter & Folwell; Chas. F. Schwenk, Secy.

PHILADELPHIA, PA.—The finance committee has approved of the proposed appropriation of $250,000 for relining the Roxborough and Queen Lane reservoirs.

SELLERSVILLE, PA.—The citizens have voted to issue $20,000 in bonds for works.

BALTIMORE, MD.—A New York contractor is reported to have been awarded a contract by the Chesapeake Electric & Water Co., of Canton, for the construction of works, to cost about $70,000, to supply Canton, Highlandtown, Orangeville and adjacent places.

NORFOLK, VA.—Bids are asked until June 15 for putting in a system of driven wells, as stated in our advertising columns. R. Y. Zachary, Supt.

ST. AUGUSTINE, FLA.—The aldermen are considering a resolution providing for an issue of bonds for water-works, etc.

GREENEVILLE, TENN.—The contract for pipe for the works has been awarded to the Chattanooga Pipe & Foundry Co. H. Reaves will have the management of the new works.

CLEVELAND, O.—Bids are asked by the park commissioners until May 22 for furnishing and laying 4,000 ft. of 4-in. pipe.

DAYTON, O.—F. J. McCormick, of this city, and other trustees of the Dayton asylum for the insane have asked for an appropriation of $4,000 for sinking wells to supply the asylum with water.

TOLEDO, O.—Bids are asked until June 4 for 2,800 tons of 30-in. pipe, with valves, etc. T. R. Cook, Supt.

WESTWOOD, O.—The citizens have voted, 81 to 3, to issue $20,000 in bonds for works.

ALEXANDRIA, IND.—Bids are asked until June 8 for constructing works on a 25-year franchise plan, as described in our advertising columns. Consult. Engr., Geo. W. Sturtevant, Jr., Chicago; J. D. Wallingford, Cy. Clk.

LAKEVIEW, MICH.—An election was held May 14 to vote on an issue of $8,000 in bonds for works.

NILES, MICH.—The citizens have voted to issue $50,000 in bonds to complete the works.

STANDISH, MICH.—William A. Smith, Clk., writes us that the water question is not yet definitely settled, but that it is probable that nothing will be done this summer except to keep the old works in repair.

CHICAGO, ILL.—The contracts for laying water pipe in Garfield and Union parks have been awarded to James Murphy, at $9,104 and $2,310, respectively.

ELMWOOD, ILL.—Bids are asked until May 31 for sinking an artesian well. It is the intention of the council to construct works at once, for which $17,000 was recently voted. Consult. Engr., Chas. F. Sturtevant, St. Louis; J. L. Gilbert, Cy. Clk.

HARLEM (P. O., Oak Park), ILL.—Bids are asked until May 25 for constructing works, including about five miles of 12 to 4-in. pipe. Henry C. Meier, Village Clk.

HIGHLAND PARK, ILL.—Bids are asked until May 21 for about 3,500 ft. of 8 and 6-in. extensions. H. L. Bowen, Cy. Engr.

HILLSBORO, ILL.—F. P. Winchester, Cy. Clk., writes us that the council has decided to do its own work in regard to increasing the water supply. Wm. Vanter, Chn. Com.

JOLIET, ILL.—Plans and specifications have been prepared for extensive alterations of the works, according to reports.

WENONA, ILL.—Bids are asked until May 30 for a steel reservoir, deep well pumping engine, etc. John Judd, Cy. Clk.

DEERFIELD, WIS.—It is reported that bids are being received for constructing works in this village.

FORT ATKINSON, WIS.—The citizens are reported as agitating the question of works.

GRANTSBURG, WIS.—W. B. Maxwell writes us that the contract for constructing works has been awarded to J. M. Carroll, of Grand Forks, N. Dak., at $3,000, all machinery to be furnished by the village. O. H. Olsen & Co., Stillwater, Minn., bid $6,941 for a complete plant.

PORTAGE, WIS.—W. G. Maxey has been appointed receiver of the Portage Water Co.

TREMPEALEAU, WIS.—At a public meeting May 6 the citizens decided to put in works, including a reservoir at an elevation of 300 ft. above the village.

ADEL, IA.—A contract for works is reported to have been awarded to a Des Moines party, the work including a stand-pipe.

POSTVILLE, IA.—Bids are asked until June 1 for the construction of works, including a stand-pipe. Wm. Shepherd, Recdr.

COFFEYVILLE, KAN.—The citizens voted May 7 to issue bonds for works.

EVELETH, MINN.—A special election was held May 9 to vote on an issue of $3,000 in bonds for works.

ST. CHARLES, MINN.—G. T. Olds, Mayor, writes us that bids will be opened about June 1 for constructing works, including 2½ miles of main, 35-HP. steam

pump, 700-ft. well, 7,000-bbl. reservoir. Engr., Fred. H. Pickles, Winona.

STEWARTVILLE, MINN.—An election will be held May 18 to vote on an issue of $5,000 in bonds for works.

WINDHAM, MINN.—It is reported that an election will soon be held to vote on the question of constructing works and an electric light plant.

BROOKFIELD, MO.—The citizens have voted to issue $10,000 in bonds for works.

FORREST CITY, ARK.—A water company is reported to have secured an artesian supply and as now erecting a windmill for pumping power. It is stated that the city will lay mains, etc.

EL PASO, TEX.—It is expected that the contract for municipal works will be awarded the latter part of June or early in July. Consult. Engr., John B. Hawley, Fort Worth, Tex.

LANCASTER, TEX.—Will A. Strain, Secy. Lancaster Water, Light & Ice Co., writes us that bids were to be received May 10 for machinery for sinking well and that other contracts will not be awarded until a water supply is secured.

PAWHUSKA, OKLA.—Bids are asked until June 19 for constructing works at the Osage Indian Agency. Lieut.-Col. H. B. Freeman, U. S. Indian Agent.

CASPER, WYO.—The business men are reported to have subscribed sufficient money to sink an artesian well at least 1,000 ft. deep, and it is reported that the machinery has been secured.

COLLINGWOOD, ONT.—Bids are asked until May 21 for 4,300 ft. of 12 to 4-in. pipe. 7 hydrants, etc. James Gullfoyle, Chn. Com.

SWEETSBURG, QUE.—The council is reported as considering plans for constructing works.

WINNIPEG, MAN.—The city engineer has prepared plans for municipal works estimated to cost $650,000.

IRRIGATION.

RUSSELL, KAN.—Bids are asked until May 27 for constructing a pumping station to consist of well, power, pump and reservoir, in Haskell county. Wm. B. Sutton, Secy. State Bd. Irrigation.

RAWLINS, WYO.—Press reports state as follows: Specifications have been prepared and the contract will soon be awarded for the construction of a canal 40 miles long, on Snake River, 70 miles south of Rawlins, to irrigate a large tract of arable land for colonization. The enterprise is backed by Providence, R. I., parties. Prof. Elwood Mead, State Engr., lately completed an examination of the plans.

NEW COMPANIES.—Crown Butte Canal & Reservoir Co., Sun River, Mont.; $100,000; E. D. Hastie and others.

Lower Powder Irrigation Co., Keating, Ore.; $5.0; A. T. Karum, H. P. Cranston, William Merrin.

San Dimas Reservoir & Water Co., Los Angeles, Cal.; $100,000, with $650 paid in; to build irrigating ditches, etc.; C. M. Wells, R. Dunnigan, L. C. Wells, J. A. Anderson.

Rio Puerco Irrigation Co., Albuquerque, N. Mex.; $500,000; W. I. McMasters, Chicago, Ill.; John B. Fitsett, New York; Chas. W. Lewis, H. R. Whiting, W. F. Clancy, Denver, Colo.

Buenos Ayres Water Co., Los Angeles, Cal.; $100,000, with $54,000 paid in; to build irrigating ditches, etc.; John Wolfskill, Henry W. Denker, Walter N. Wolfskill, Walter J. Trask, Los Angeles.

Rio Grande Electric Power & Irrigation Co., Santa Fe, N. Mex.; to build an irrigation ditch at White Rock canyon, five miles above Canada de Cochite; A. H. Handlan, T. M. Murray, St. Louis; Levi Ellis, New York; J. H. Purdy, Santa Fe.

SEWERAGE.

ANDOVER, MASS.—Abraham Marland, Town Clk., writes us that no money has yet been appropriated for sewers, the question being still before the legislature.

LAWRENCE, MASS.—The council has adopted an ordinance to issue $45,000 in bonds for constructing sewers in Ward 6. A. D. Marble, Cy. Engr.

SALEM, MASS.—A bill is in the legislature authorizing the state board of health to make surveys for a system in Salem and Peabody.

WEBSTER, MASS.—L. A. Taylor, of Worcester, and John A. Whitaker are preparing plans for extending the system. The town voted in April to issue $20,000 in bonds for sewers. L. J. Upham, Town Clk.

NEW BRITAIN, CONN.—John W. Waters, Cy. Clk., writes us that extensive plans for sewers in West Main St. and Berlin Ave. have been ordered, and are under consideration. Other smaller sections are to be constructed. The sewers this year will be constructed by day labor.

ALBANY, N. Y.—Robt. H. Strong has been awarded the contract for constructing the Beaver Creek sewer from Lexington Ave. to Partridge St., at $62,863, the other bids being Wm. J. McCan, $78,976; Peter Callanan, $87,761; John Snaith, $67,354; Troy Public Works Co., $73,638; Wm. M. Dunn, $73,877, and T. H. Dumary, $68,600.

BROOKLYN, N. Y.—The following were the lowest bids received for constructing cement pipe sewers in Ward 26: Subdivision 10, McKeever & Bros., $23,534; subdivision 11, McKeever & Bros., $26,465; subdivision 17, James F. Gillen, $35,857; subdivision 19, Edward Gorman, $26,758; subdivision 20, Edward Gorman, $23,733.

BUFFALO, N. Y.—Bids are asked until May 28 for constructing 15 to 10-in. pipe sewers in four streets. R. G. Parsons, Secy. Dept. Pub. Wks.

CHATEAUGAY, N. Y.—It is reported that the commissioners will advertise at once for bids for constructing sewers, for which $5,000 was recently voted by the citizens.

FULTON, N. Y.—Amin Rice, Clk. Comrs., writes us that the proposition to build 77,200 ft. of 20 to 8-in. pipe sewers, estimated to cost $67,700, was voted down at an election held April 4. Nothing further has been done. Engr., Reeves Smith, Troy.

GOWANDA, N. Y.—Hedenberg & Kinsey, 106 Fulton St., New York, have been engaged to design and superintend the construction of a system.

ITHACA, N. Y.—We are informed that no engineer has been appointed by the board of commissioners for the proposed sewers, noted last week.

SYRACUSE, N. Y.—The committee has recommended the construction of a 20-in. brick sewer in University Place, and 20 to 12-in. pipe sewers in four streets.—— The city engineer has recommended the construction of 87 to 24-in. brick sewers in two streets, and 18-in. pipe sewers in two streets.

WARSAW, N. Y.—The council has passed a resolution to construct 24 to 10-in. pipe sewers in four streets.

NEWARK, N. J.—Plans have been prepared for the Clinton township committee for a brick trunk sewer in Clinton Ave. to the Newark main sewer, estimated to cost $30,000.

ALTOONA, PA.—McGlathery & Bennett, of Greensburg, have been awarded the contract for constructing two pipe sewers, at $4,777.

BRIDGEPORT, PA.—The council has voted to build a sewer in De Kalb St., at an estimated cost of about $7,000.

WILLIAMSPORT, PA.—The following bids were received May 9 for constructing pipe sewers, as advertised in Engineering News: Berry & Day, Bellaire, O., $9,129, awarded contract; D. P. Guise, Williamsport, $9,524; Ward & Stucker, Harrisburg, $9,737; McCloud & Co., Williamsport, $9,906; Thomas McGuigan, Meadville, $10,171; A. H. Coon & Son, Kingston, $10,519; Sowders & Houston, Pittsburg, $10,887; Dodge & McGregor, Buffalo, $10,940; Bowman Bros., McKeesport, $14,902. S. George, Cy. Comptroller.

CLEVELAND, O.—Local papers state that within two or three weeks Mayor McKisson will recommend to the council that a commission of five be appointed to prepare plans for taking care of the sewage of the city. Heretofore no permanent plan has been adopted. Sewer outlets were placed wherever they would reach the lake or the river, and be of least expense to the city.

SALEM, O.—Plans have been completed for a brick sewer, estimated to cost $17,682.

PLYMOUTH, IND.—Bids are asked until May 27 for constructing the Jefferson and Yellow River sewer. W. E. Leonard, Jr., Cy. Clk.

ANN ARBOR, MICH.—Bids are asked until May 31 for constructing 17½ miles of 15 to 4-in. pipe sewers, as stated in our advertising columns. Plans are also being prepared for additional work, which will not be ready for about six weeks. Geo. F. Key, Cy. Engr.; Geo. V. Mills, Cy. Clk.

HARLEM, ILL. (P. O., Oak Park, Ill.)—Bids are asked until May 25 for constructing a brick and pipe sewer. Robt. E. Williams, 712 Oxford Bldg., Chicago; Henry C. Meier, Village Clk.

McCOMB, ILL.—W. E. Thompson, Chn. Com., writes us that the county and city expect to build 5,000 ft. of 18-in. pipe sewer, average cut 8 ft. Work will commence as soon as plans and specifications are ready. The engineer has not yet been selected.

PEKIN, ILL.—The council has adopted plans for a system prepared by Hardman & Evans, of Peoria. J. C. Aydelott, Cy. Engr.

MILWAUKEE, WIS.—Bids are asked by the board of public works until May 17 for constructing 1,500 ft. of the west side sewer, estimated to cost $40,000 to $45,000. Geo. H. Benzenberg, Cy. Engr.

RACINE, WIS.—O. Burlingame, Cy. Engr., writes us that it is proposed to construct one mile of 96 to 36-in. brick sewer, part in tunnel, estimated to cost $50,000.

MASON CITY, IA.—The extension of the system is being considered.

ST. JOSEPH, MO.—The council is considering an appropriation of $12,000 for sewers.

FRESNO, CAL.—It is reported that the city voted May 4 to issue $40,000 in bonds to complete the system.

GARBAGE DISPOSAL.

SYRACUSE, N. Y.—The mayor has directed the American Reduction Co. to commence the construction of the garbage disposal plant in Ward 15 at once.

PITTSBURG, PA.—Chas. Flinn, who recently received the garbage disposal contracts in this city, is reported as tearing down buildings on the bank of the river preparatory to building a furnace to burn 100 tons of garbage daily.

WASHINGTON, D. C.—The district commissioners have awarded a contract for collecting and disposing of the garbage of the city for four months to Edwin Warfield, of Baltimore, at $28,500, according to local papers. It is stated that a contract for five years will be awarded at the expiration of the four months.

STREETS AND ROADS.

PORTLAND, ME.—The council has passed a resolution to pave Congress St., at an estimated cost of $9,000.

CAMBRIDGE, MASS.—Bids are asked until May 22 for grading, etc., the roads at Hobb's Brook storage basin in Lincoln and Lexington, the work including 216,000 cu. yds. of earth excavation, 42,000 cu. yds. of filling and grading, 3,500 cu. yds. of surfacing, etc. L. M. Hastings, Cy. Engr.

NATICK, MASS.—Bids are asked for 3,500 sq. yds. of concrete walks. W. W. Wight.

GLENDALE, R. I.—Bids are asked until May 24 for widening a roadway, ripraping slopes and setting posts on the highway across Baker's Cove. Address, E. L. Tucker, Nasonville.

BRIDGEPORT, CONN.—The question of paving either Broad St. or Main St. with asphalt is being discussed.

NEW BRITAIN, CONN.—John W. Waters, Cy. Clk., writes us that plans are being prepared for paving Main St. with Belgian blocks.

ALBANY, N. Y.—The following bids have been received for paving Madison Ave. with granite blocks: T. Henry Dumary, $38,849, awarded contract; Patrick W. Mulderry, $41,778; R. H. Strong, $39,878; John Smith, $41,469; Peter Callanan, $41,659, and Michael J. Dady, $46,706.

AUBURN, N. Y.—The city surveyor estimates the cost of paving State St. with sandstone at $10,000.

BROOKLYN, N. Y.—Bids are asked until May 28 for paving a portion of Degraw St. with cobblestones. A. T. White, Comr. Cy. Wks.

DOLGEVILLE, N. Y.—Bids are asked until June 1 for constructing about 30,000 sq. ft. of concrete sidewalk, as stated in our advertising columns. Engr., Wm. H. Collis. Address Alfred Dolge, Land Dept.

ELMIRA, N. Y.—L. D. Little, John B. Stanchfield, and others have petitioned the council to pave a portion of Madison Ave. with asphalt.

FREDONIA, N. Y.—We are informed that West Main St. is to be paved with brick. It is probable that a number of other streets will also be paved. P. M. Parker, Cy. Engr.

ITHACA, N. Y.—It is expected that 15,000 sq. yds. of brick pavements will be constructed this season. Henry A. St. John, Supt. Pavement Com.

MAMARONECK, N. Y.—The supervisor has been granted permission to borrow $5,500 for the improvement of Weaver St.

MOUNT VERNON, N. Y.—Bids are asked until May 22 for paving First St. with brick. E. G. Pease, Cy. Clk.

NEW YORK, N. Y.—Bids are asked by the department of public works until May 22 for 5,522 sq. yds. of pavement of rock asphalt with concrete base, 777 sq. yds. of pavement of rock asphalt with concrete base, including rubble-stone foundation, and for paving portions of six streets with asphalt on concrete foundation, 12 streets with granite blocks and one street with macadam.——The following bids were received by E. L. Allen, Secy. Aqueduct Comm., for constructing a road in Kent, Putnam county:

William T. McCabe, Mamaroneck, N. Y.	$18,567
William E. Nolan, Sing Sing, N. Y.	12,185
Martin & Murray, 14th and Hutton Sts., Troy	21,490
McNiece, Cuozzo & Co., 146 B'way, New York	14,765
Bellew & Merritt, Tuckahoe, N. Y.	13,477
Troy Public Works Co., 27 Hall Bldg., Troy	17,388
John Flanagan, Carmel, N. Y.	15,570
Clapp & Shipman, 45 Broadway, New York	23,659
Dougherty & Berrigan, Yonkers, N. Y.	17,997
Thomas McCormick, Sing Sing, N. Y.	15,925
John Twiname, 2033 Bathgate Ave., New York	15,969

PORT RICHMOND, N. Y.—Louis Freeman has been appointed surveyor for a new avenue provided for by a bill passed by the legislature.

POUGHKEEPSIE, N. Y.—The council has been petitioned to pave Union St. with asphalt blocks.

ROCHESTER, N. Y.—The following bids have been received for paving Central Ave. with Medina blocks, estimated to cost $25,000: Whitmore, Rauber & Vicinus, $21,950; William Fuller, $22,255; Chambers & Casey, $22,256; Bruff & Stewart, $22,429; W. H. Jones & Sons, $22,787; Gilbert, Brady & Co., $22,792; Lauer & Hagaman, $23,044; E. L. & H. T. Oliver, $24,207; H. N. Cowles, $24,480.

SYRACUSE, N. Y.—Bids are asked until May 20 for paving West Fayette St. with sheet asphalt. M. F. Stephens, Cy. Clk.

BELLEVILLE, N. J.—The question of issuing bonds for macadamizing will be voted on May 15.

JOHNSTOWN, PA.—The committee has recommended the paving of portions of seven streets with brick, estimated to cost $30,500.

PHILADELPHIA, PA.—Bids are asked until May 27 for grading and paving several alleys with impervious pavement. Theo. B. Stubb, Health Officer.

SCRANTON, PA.—The mayor has signed the ordinance authorizing the repaving of Penn Ave. with sheet asphalt, estimated to cost $5,500.

WASHINGTON, PA.—Bids are asked until May 18 for grading East Bean St. in East Washington, preparatory to paving, according to report.

BALTIMORE, MD.—Bids are asked until May 21 for furnishing crushed stone for macadamizing two streets and gravel for repairing five streets. A. E. Smyrk, Cy. Comr.

LOUISVILLE, KY.—Bids are asked by the board of public works until May 21 for repaving portions of 16 streets with brick. J. H. Hoertz, Secy.

ASHTABULA, O.—Bids are asked until June 1 for 20,000 sq. yds. of brick paving, estimated to cost $41,335. H. E. Mann, Cy. Engr.

CINCINNATI, O.—Bids are asked by the board of administration until June 6 for paving Court St. with granite blocks.

COLUMBUS, O.—Bids are asked until May 21 for grading and macadamizing a portion of Knickerbocker Ave. J. A. Fanning, Clk. Bd. Pub. Wks.

CLEVELAND, O.—Bids are asked until May 22 for 9,000 sq. yds. of Telford macadam for Doan Brook Parkway. C. W. Pratt, Jr., Ch. Engr., Bd. Park Comrs., 717 Hickox Bldg.——The following bids were received by the council May 6 for paving a portion of Euclid Ave.:

M. F. Bramley	$36,041
The Albion Stone Co.	36,615
The N. O. Paving & Const. Co.	37,635
L. & J. F. Brennan	37,328
Lauer & Shields	37,478

INDIANAPOLIS, IND.—Bids are asked until May 18 for 3,942 lin. ft. of asphalt paving on West and Prospect Sts. Bids for this work were received May 4, but rejected because the land asphalt was not considered equal to Trinidad Lake pitch asphalt, and the others because they were considered too high. The bids were published last week under Contract Prices. ——Bids are asked until May 21 for 13,213 sq. yds. of brick paving in Clifford Ave. Bids were received for this work March 28 for asphalt, but the bids were rejected. The bids were published April 11 under Contract Prices.——Bids are asked until May 21 for 2,393 sq. yds. of asphalt paving.——Plans have been ordered for about 3,420 lin. ft. of asphalt paving in two streets and about 1,000 lin. ft. of cement sidewalks in three streets. Chas. C. Brown, Cy. Engr.

TERRE HAUTE, IND.—Bids are asked until May 21 for brick and Portland cement paving in a number of streets and alleys. Chas. H. Goodwin, Cy. Clk.

TIPTON, IND.—L. Vernon Gould, Cy. Engr., writes us that the council has passed a resolution for paving three squares on Dearborn St. and one square on Tipton St. with brick.

ANN ARBOR, MICH.—Geo. F. Key, Cy. Engr., writes us that the board of public works wishes bids for paving brick in carload lots, f. o. b., as it is planning to put in a number of street crossings with brick instead of cement.

SAULT STE. MARIE, MICH.—Chippewa county has voted to issue $100,000 in bonds for building roads.

CHICAGO, ILL.—Bids are asked until May 20 for

improving portions of 12 streets and alleys. W. D. Kent, Comr. Pub. Wks.

RACINE, WIS.—O. Burlingame, Cy. Engr., writes us that it is proposed to lay cedar block paving estimated to cost $34,000, brick paving estimated to cost $10,000, and stone paving estimated to cost $8,000.

BURLINGTON, IA.—The city engineer has been directed to advertise for bids for paving three streets with brick.——It is proposed to pave other streets.

KANSAS CITY, MO.—Bids are asked until June 1 for grading a portion of Cypress Ave., in Jackson county. F. J. O'Flaherty, County Surv.

CONTRACT PRICES.

SEWERS.—Brockton, Mass.—F. Herbert Snow, Cy. Engr., informs us that the contract for constructing portions of sections 9 and 10 of the sewerage system have been awarded to Brigham & Cates, at $34,811, and that for portions of sections 11 and 12 to the Morgan & Booth Construction Co., at $18,085. The bids were opened May 6, and were as follows:

Bids Received at Brockton, Mass., for Constructing Sewers.

Sections 9 and 10:

Quantities.		Brigham & Cates.	A. W. Bryne.	D. O'Connell.	F. L. Allen.	Moulton & O'Mahoney.	White & Wetherbee.	W. T. Davis.
Excavation, 0 to 9 ft. deep,	26,246 cu. yds.	$0.46	$0.50	$0.65	$0.60	$0.58	$0.73	$0.85
" 9 " 15 " "	4,130 " "	1.00	.75	1.00	1.00	1.17	.73	1.15
" 15 " 21 " "	569 " "	1.50	1.50	1.50	1.50	1.82	.73	1.50
Brick masonry	821 " "	10.45	11.00	10.50	10.25	11.58	12.00	11.75
Concrete masonry	516 " "	4.95	5.00	4.50	5.00	4.27	5.00	5.25
Rubble masonry	20 " "	4.00	6.00	6.00	6.00	4.27	8.00	6.00
Sewer pipes	20,397 ft.	.10	.15	.12	.13	.13	.15	.12
Underdrains	24,107 "	.15	.30	.20	.25	.50	.48	.20
Chimneys	208	.15	.10	.10	.05	.10	.20	.10
30-in. iron pipe	908 ft.	.50	1.00	.45	.50	.75	1.00	.45
Lumber in place	10 M. ft.	40.00	40.00	30.00	40.00	32.00	35.00	30.00
Total		$34,811	$40,425	$41,104	$41,389	$48,613	$51,112	$54,450

Sections 11 and 12.

Quantities.		Morgan & Booth Const'n Co.	Brigham & Cates.	A. W. Bryne.	Dennis O'Connell.	F. L. Allen.	Moulton & O'Mahoney.	W. T. Davis.
Excavation, 0 to 9 ft. deep,	15,212 cu. yds.	$0.53	$0.49	$0.50	$0.75	$0.70	$0.56	$0.85
" 9 " 15 " "	2,904 " "	.66	1.00	.75	1.00	1.25	1.10	1.15
" 15 " 21 " "	197 " "	.80	1.50	1.50	1.50	1.75	1.75	1.40
Brick masonry	230 " "	9.00	10.95	11.00	11.00	10.00	12.00	12.00
Concrete masonry	350 " "	4.00	4.95	5.00	4.50	5.00	4.27	5.25
Rubble masonry	20 " "	6.00	4.00	6.00	6.00	6.00	4.27	6.00
Pipe sewers	15,748 ft.	.13	.10	.15	.12	.15	.15	.17
Underdrains	13,252 "	.15	.15	.30	.20	.25	.50	.43
Chimneys	200	.07	.15	.10	.10	.05	.10	.07
Lumber in place	10 M. ft.	25.00	40.00	40.00	30.00	40.00	32.00	35.00
Total		$18,085	$19,067	$21,305	$23,784	$24,991	$25,369	$30,106

BRICK PAVING AND CURBING.—Des Moines, Ia.—Bids have been opened for about $100,000 worth of paving and curbing, the lowest for curbing being I. M. McGavern, at 20½ and 30 cts., and the lowest for paving with brick on concrete base, with cement filler, being G. M. Fiscus, J. B. Smith & Co., the Des Moines Brick Mfg. Co. and Bryan & Youngerman, at $1.36 and $1.37 per sq. yd.; for two courses of brick, G. M. Fiscus, H. A. King, J. B. Smith & Co., and King & Kennedy, at $1.12 to $1.16. It is stated that J. B. Smith & Co., of Chicago, and G. M. Fiscus, of the Des Moines Brick Mfg. Co., secured most of the work.

SEWERS.—Medford, Mass.—The lowest bid for constructing section 16 of the sewer system was noted May 2, under Sewerage. T. Howard Barnes, Cy. Engr., informs us that the itemized bids were as follows:

BRICK PAVING.—Tipton, Ind.—L. Vernon Gould, Cy. Engr., writes us that contracts for paving with one course of brick upon 8 ins. of gravel foundation, as advertised in Engineering News, have been awarded as follows: Lalley & Phillips, Main St., at $1.09 per sq. yd. for Hallwood blocks, and Madison St., at $1.19 for Hallwood blocks; Porter, Barlow Co., Jefferson St., at $1.15½ for Canton blocks. The bidders were as follows: Lalley & Phillips, Redkey, Ind.; Daniel Folley, Indianapolis; Fries, Barr & Co., Greenfield, Ind.; Jas. W. Wildering & Co., Indianapolis; Joe Innis, Tipton, Ind.; Cronin & Epperson, Anderson, Ind.; D. I. Dalton, Anderson, Ind.; Wheeler & Cottingham, Noblesville, Ind.; E. M. Ayers, Lanesville, O.; P. T. O'Brien, Elwood, Ind.; C. M. Kirkpatrick, Greenfield, Ind.; Porter, Barlow & Hadley, Tipton, Ind.

Bids for electric lighting:

People's Light & Power Co.	$105.00
People's Electric Light & Power Co.	105.00
Hyde Park Light & Power Co., construction done by city.	81.00
On lamps now on its own wires.	84.00
Construction of poles, wires and lamps.	107.50
Mutual Electric Light & Power Co.	82.00

The only bid for the 8,400 gasoline lamps in the city was from the Globe Light & Heat Co., at $15 per lamp on its own lamps, and $13.50 on the lamps controlled by the city, which numbers almost 4,200.

WATER-WORKS.—Maywood, Ill.—S. H. Donaldson, Jr., Village Clk., writes us that the contract for constructing works, as advertised in Engineering News, has been awarded to Thatcher & Burke, the construction to be commenced May 27 and completed Nov. 1. The Rensellaer valves and Michigan Brass & Iron Works' hydrants were adopted. The bids were as follows:

Bidder.	147,807 ft. of 4, 6, 8, 10, 12-in. pipe with specials.	380 hydrants complete with manholes.	125 valves complete, with manholes.	Total.
Dan. Hardin, Chicago	$88,782	$14,832	$3,384	$106,998
S. J. Pape & Co., Chicago	82,717	13,373	2,379	98,470
Gahan & Byrnes, Chicago	90,041	13,349	2,567	105,958
Blake, Steck & Ferral*	76,566	21,639	4,448	102,944
J. Murphy, Chicago	79,978	21,424	4,362	105,764
Chas. Porter, Maywood, Ill.	83,183	14,461	3,440	101,084
Taft & Dale, Dubuque, Ia.	88,854	25,768	6,400	121,022
Grimes & Moran, Elkhart, Ind.	76,346	22,645	Incld.	98,991
Thatcher & Burke, Chicago.	73,748	15,744	3,352	92,844
Hanlon & Knepper, Sioux City	77,910	15,510	3,550	96,970
Farley & Green, Chicago	84,117	13,184	2,915	100,216
Seckner Const'n Co., Chicago	100,945	9,064	1,493	111,502
J. E. Willard, Crescent Hill, Ky.	83,193	20,925	5,150	109,267
J. H. Roche, Chicago.	86,336	19,634	4,118	109,489
A. J. McBean & Co., Chicago	97,902	21,836	4,822	124,560
B. C. Morgan, Chicago	80,189	23,731	5,550	118,470
C. & T. Inglehart, Morgan Park	82,822	16,274	3,749	102,845
John Healy, Chicago	77,085	16,068	3,449	96,603

* Sioux City, Ia.

PIPE, HYDRANTS, ETC.—Kalamazoo, Mich.—The water board has awarded the following contracts: Lake Shore Foundry, pipe, at $18.05 per ton, and specials at $40; Ludlow Valve Mfg. Co., hydrants, at $34.50 and $23.50, and valves, at $7, $11.30, $17.25 and $25.60; Wilson Foundry & Forge Co., castings, at $25 per ton.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

STREET SIGNS.—Norwood, O.—The committee on streets has been authorized to replace street signs throughout the village.

FIRE ENGINE.—Prentice, Wis.—E. E. Whiting, Town Clk., writes us that the town anticipates buying a steam fire engine.

SURVEYS.—Albany, N. Y.—Governor Morton has signed a bill appropriating $8,000 for a survey of the upper Hudson River valley.

DREDGING.—Tompkinsville, N. Y.—Bids are asked until May 29 for dredging in the basin at this place. Lieut.-Col. Peter C. Hains, U. S. Lighthouse Engr.

STEAM ROAD ROLLER.—Toronto, Ont.—Bids are asked until June 1 for a 12-ton steam road roller, as stated in our advertising columns. Daniel Lamb, Chn. Com.

CEMENT AND SAND.—Portland, Me.—Bids are asked until May 31 for a supply of cement and sand, as stated in our advertising columns. Maj. D. P. Heap, U. S. Engr. Office.

FILLING, ETC.—Marysville, Cal.—It is reported that an election will soon be held to vote on an issue of $40,000 in bonds to fill a part of the slough and improve the system of drainage.

FOUNDATION FOR LOCK.—New Orleans, La.—Bids are asked until June 6 for cofferdam, excavation and piling foundation for lock at Plaquemine, La. Maj. Jas. B. Quinn, U. S. Engr. Office.

JETTY WORK.—Montgomery, Ala.—Bids are asked until June 27 for jetty work at entrance to Pensacola Harbor, Fla., as stated in our advertising columns. Maj. F. A. Mahan, U. S. Engr. Office.

DREDGING.—New York, N. Y.—Bids are asked by the department of docks until May 21 for 15,000 cu. yds. of dredging in the Harlem River; also for 100,000 cu. yds. of dredging in the North River.

PIER WORK.—Philadelphia, Pa.—The board of port wardens has granted licenses for extending piers to the Pennsylvania R. R. Co. and to the estate of B. F. Clyde. Other applications are being considered.

Bids Received at Medford, Mass., April 27, 1895, for Constructing Sewers.

Quantities.		H. A. Hancom & Co., Everett, Mass.	J. Sheehan & Co., Lynn, Mass.	Morgan & Booth, Trenton, N. J.	Ambrose Bobbitt, Torrington, Conn.	Lindsey & Cudmore, Somerville, Mass.	D. O'Connell, Dorchester, Mass.	A. W. Bryne, W. Medford, Mass.	John H. Leavitt, Boston, Mass.	Geanaro, Long & Little, South Braintree, Mass.	Brigham & Cates, Boston, Mass.	Fairey & Buttimer, Somerville, Mass.	Weaving, Booth & Parry, Medford, Mass.	F. L. Allen, Worcester, Mass.	Trumbull & Ryan, Boston, Mass.	D. F. McCarthy, Lawrence, Mass.
Earth excavation, 0 to 8 ft. deep,	20,750 cu. yds.	$0.40	$0.36	$0.395	$0.38	$0.52	$0.40	$0.40	$0.45	$0.53	$0.40	$0.60	$0.60	$0.55	$0.73	$0.70
" " 8 " 14 " "	2,300 " "	.55	.36	.60	.55	.52	.75	.60	.90	.85	.75	.75	.75	.90	.93	.90
" " 14 " 20 " "	50 " "	1.00	.36	1.00	.75	1.00	1.00	1.00	1.50	1.50	2.00	1.00	1.25	1.50	1.13	.90
Rock " 0 " 8 " "	4,870 " "	3.00	4.00	3.25	4.00	4.00	4.00	4.00	4.00	3.50	4.99	4.00	4.50	4.50	4.75	6.00
" " 8 " 14 " "	910 " "	4.00	4.00	4.00	5.50	4.00	4.50	5.00	5.00	6.00	5.99	6.00	5.50	5.50	7.00	6.00
" " 14 " 20 " "	20 " "	6.00	4.00	5.00	6.00	4.00	5.00	6.00	6.00	8.00	6.00	6.00	6.50	7.00	12.00	6.00
Brickwork	450 " "	4.50	4.50	4.25	6.00	4.00	4.85	5.00	5.25	4.75	5.50	5.00	5.00	5.00	5.00	6.00
Concrete	150 " "	4.00	1.00	4.25	2.50	3.00	4.00	5.00	5.75	4.00	5.00	3.00	6.00	4.50	4.50	5.00
Rubble	20 " "	6.00	1.00	7.00	2.50	3.00	3.00	5.00	4.00	5.00	5.00	5.00	3.00	3.00	3.50	5.00
6 to 12-in. pipe sewers	27,240 lin. ft.	.10	.15	.10	.05	.05	.15	.10	.08	.15	.13	.15	.10	.17	.12	.10
15 " 18-in. " "	2,700 " "	.10	.15	.40	.08	.05	.15	.15	.10	.20	.15	.22	.20	.20	.18	.15
Pipe chimneys	200 " "	.10	.01	.04	.25	.05	.05	.10	.09	.10	.15	.06	.05	.05	.10	.05
Subdrain pipe laid	25,000 " "	.15	.04	.15	.05	.10	.05	.15	.15	.10	.15	.20	.20	.20	.16	.25
Spruce lumber in place	8 M. ft.	40.00	20.00	25.00	26.00	35.00	26.00	40.00	30.00	35.00	35.00	30.00	40.00	35.00	30.00	35.00
Spruce piles driven	600 lin. ft.	.30	.20	.30	.25	.15	.25	.30	.40	.30	.40	.30	.25	.40	.35	.30
Totals		$37,994	$39,484	$39,826	$40,153	$41,923	$42,701	$44,379	$45,635	$46,136	$51,568	$52,197	$53,241	$54,303	$58,305	$64,839

BRICK PAVING.—Indianapolis, Ind.—The contract for paving Pearl St., from Cap.tol Ave. to Mississippi St., with brick was let on May 4 to the Indiana Paving Brick Co. at $1.91 per lin. ft. of each side of the street, with its own brick and stratified limestone curb, except granite round corners, and Portland cement filling. Browder & Shover bid $2.28 on Hallwood block, $2.29 on Harris block and $2.27 and $2.29 on Clinton standard and repressed brick. The Capitol Paving & Construction Co. bid $2.40 on Wabash block, Fulmer-Seibert Co. bid $2.47 and $2.53 on Clinton standard and repressed brick, and the Fruin-Bambrick Construction Co., of St. Louis, bid $2.99 on Mack brick. The street is 420 ft. long and 20 ft. wide, has 900 sq. yds. of surface, 770 ft. of curb, 47 ft. of granite round corners, and 30 ft. of marginal stone. The contract for paving Pearl St., from Delaware St. to Alabama St., which is the same as above, except that the length is 420 ft. and the area 959 sq. yds., was let to the same firm at $2.69 Bid were received from all those mentioned, and were usually 19 cts. higher than on the above section.

CAST IRON PIPE.—Syracuse, N. Y.—W. R. Hill, Ch. Engr. Water Board, writes us that 12 bids were received for a supply of pipe, as advertised in Engineering News, and that the contracts will be awarded to the lowest bidders, as follows:

Section A—Buffalo Cast Iron Pipe Co., Buffalo, N. Y., 1,720 tons 36 and 38-in. pipe, at $16.95 per ton; 140,000 lbs. of special castings, at 2 cts. per lb.

Section B—Anniston Pipe & Foundry Co., Anniston, Ala., 2,250 tons 24 to 16-in. pipe, at $17.30; 140,000 lbs. special castings, at 2 cts.

Section C—Jackson & Woodin Mfg. Co., Berwick, Pa., 1,320 tons 12 to 6-in. pipe, at $17.92; 90,000 lbs. special castings, at 1.9 cts.

Section D—Chattanooga Foundry & Pipe Works, Chattanooga, Tenn., 940 tons 12 to 6-in. pipe, at $18.30; 65,000 lbs. special castings, at 2 cts.

Section E—Howard-Harrison Iron Co., Bessemer, Ala., 1,250 tons 12 to 6-in. pipe, at $18.30; 90,000 lbs. special castings, at 2 cts.

Section F—Anniston Pipe & Foundry Co., Anniston, Ala., 800 tons 12 and 10-in. pipe, at $18.10; 60,000 lbs. special castings, at 2 cts.

Section G—Warren Foundry & Machine Co., New York, 980 tons 8 and 6-in. pipe, at $18.70; 60,000 lbs. special castings, at 1⅞ cts.

EXCAVATION.—McKeesport, Pa.—The Fifth Ave. & High St. Bridge Co. has awarded a contract for excavating about 20,000 cu. yds. of earth in a cut in Reynoldton, to Bowman Bros., at 29 cts. per cu. yd.

ASPHALT BLOCK PAVING.—Poughkeepsie, N. Y.—E. R. Bogardus, Cy. Chamberlain, writes us that the contract for paving a section of Market St. with asphalt blocks has been awarded to the Hastings Pavement Co., at $2.75 per sq. yd.

STREET LIGHTING.—Chicago, Ill.—Bids for street lighting have been received as follows:

Bids for gas:

Chic. Gas Lt. & Coke Co., 7,539 lamps, at.	*$22.00
People's Gas Lt. & Coke Co., 18,266 lamps, at.	*22.00
Hyde Park Gas Co., 3,777 lamps, at.	*22.25
Lake Gas Co., 2,842 lamps, at.	*22.50
Suburban Gas Co., 4,192 lamps, at.	*23.00
Calumet Gas Co. 750 lamps in S. Chicago.	20.00

* A discount of $2 on each lamp is to be made if payment is made within 30 days after the expiration of the quarter of the fiscal year.

STREET SWEEPER.—Marinette, Wis.—Bids are asked until May 21 for a street sweeper, as stated in our advertising columns. E. L. Shaw, Cy. Engr.

PIER WORK.—New York, N. Y.—Bids are asked by the department of docks until May 28 for repairing the pier at the foot of East 26th St., East River.

CANAL.—Kissimmee, Fla.—Surveys are being made by the Disston Land Co., according to reports, for a canal to connect Cypress Lake with East Tohopekaliga, a distance of about six miles. The canal would drain a large tract of swamp land.

AQUARIUM WORK.—New York, N. Y.—The superintendent of the aquarium has been directed to furnish plans for improvements, estimated to cost $33,900, including the rebuilding of 36 tanks on the ground floor, a new roof over the gallery tank and a storage reservoir.

CHANNEL WORK.—Albany, N. Y.—The governor has signed a bill appropriating $8,000 for deepening and improving the channel of Bull Creek in the towns of Pendleton and Wheatfield, Niagara county, in order to drain land overflowed on account of the state dam across Tonawanada Creek.

POWDER, FORGINGS, ETC.—Washington, D. C.—Bids are asked until June 1 for supplying 8, 10 and 12-in. steel gun forgings, armor-piercing shot and steel deck-piercing shell; and until June 3 for 20,000 lbs. of powder for sea-coast guns, to be delivered at Benicia Arsenal, Cal. Brig.Gen. D. W. Flagler, Ch. of Ordnance.

TRACK ELEVATION.—Dayton, O.—Press reports state that representatives of the various railways running into the city held a conference with the city authorities May 10 and agreed to elevate the tracks from the Miami River to First St., at an estimated cost of $1,000,000. It was also agreed to erect a union station, to cost $100,000.

TELEPHONES.—Columbus, O.—The Ohio Telephone Exchange Co. has been organized to put in a competing exchange in this city.——Press reports state that the Phoenix Telephone Co., composed of Nelson Morris, J. W. Doane and other Chicago capitalists, are planning to establish a $200,000 plant here, the rates to be $12 a year.

Dalton, N. Y.—It is reported that the villages of Dalton and Nunda are to be connected by a telephone line. The enterprise is to be carried on by private individuals from the two places.

INDUSTRIAL NOTES.

THE KOUNTZ BROTHERS CO., owners of the Imperial Brick Works, at Harmarville, Pa., has decided to add a sewer pipe plant to its works.

THE NEW YORK STONE CRUSHING CO., of Poughkeepsie, N. Y., had its works at Clinton Point destroyed by fire May 9, involving a loss of $25,000.

THE AMERICAN STEEL SCRAPER CO., of Sidney, O., has been incorporated by W. E. Kilborn, D. Oldham and W. H. C. Goode, with a capital stock of $50,000.

THE PITTSBURG GAGE CO., of Pittsburg, Pa., has the contract to equip the boilers of the Philadelphia & Reading Coal & Iron Co. with Pittsburg safety water columns.

THE METAL REDUCTION CO., of Chicago, Ill., has increased its galvanizing plant, and can galvanize pieces 45 ft. in length, including rods, etc., for windmill tower work.

THE SCHULTZ BRIDGE CO., of Pittsburg, Pa., has built a steel transfer barge for carrying freight cars across the Mississippi at St. Louis. It has track capacity for 16 cars.

THE OTIS STEEL WORKS, of Cleveland, O., which was acquired by an English syndicate in 1889, has been put in the hands of a receiver, and a reorganization is probable.

THE GATES IRON WORKS, of Chicago, Ill., has built a machine shop 350 ft. long, and equipped it with a 25-ton traveling crane built by the Morgan Engineering Co., of Alliance, O.

THE WASHBURN & MOEN MFG. CO., of Worcester, Mass., manufacturing wire and wire rope, is said to have acquired control of the California Wire Works, of San Francisco, Cal.

THE PUGET SOUND GLASS CO., of Seattle, Wash., will establish extensive works near that city. Among the incorporators are W. R. Ballard, E. A. Tarbell and George W. Wilder.

THE EDGE MOOR BRIDGE WORKS, of Wilmington, Del., has the contract for two bridges on the Texas Central R. R., one being a truss span of 150 ft. and the other a plate girder span of 80 ft.

THE TENNESSEE COAL, IRON & RAILWAY CO., of Birmingham, Ala., will send a shipment of pig iron to Europe, and claims that it can undersell English pig iron if the freight rates are not too high.

THE PIERCE & MILLER ENGINEERING CO., of New York, N. Y., has secured from the Harvey Steel Co. the sole right to use the Harveyizing process for rolls, stamp shoes, dies, etc., in this country.

THE ALLEN RIVETING MACHINE CO., of Gerard Ave., New York, N. Y., informs us that the fast riveting record at the Elmira Bridge Works, noted in our issue of April 11, was made with one of its machines.

THE NEWPORT NEWS SHIPBUILDING & DRY DOCK CO., of Newport News, Va., has a contract for a fast passenger steamer 400 ft. long for the Plant Steamship Line, to run between ports on the Atlantic coast.

THE INDIANA CAR & FOUNDRY CO., of Indianapolis, Ind., has orders for 500 stock cars for the Baltimore & Ohio R. R., 200 freight cars for the Cleveland, Cincinnati, Chicago & St. Louis Ry., and 110 box cars of 60,000 lbs. capacity for the St. Louis, Vandalia & Terre Haute R. R.

THE SOUTH SIDE FOUNDRY & MACHINE CO., of Charleston, S. C., has built an endless rope haulage plant for the Montana Coal & Coke Co. The engines are of 300 HP., with cylinders 16 x 24 ins., and two rope drums 8 ft. in diameter. It has a capacity for hauling 4,000 tons per day.

THE W. J. McCLURG GAS CONSTRUCTION CO., of Pittsburg, Pa., has been incorporated, with a capital stock of $150,000, to manufacture water gas apparatus and gas motors, under patents taken out by J. H. Miller and C. R. Miller. It will also introduce the Luhrig gas motors for street cars, which are used in Germany, and have been described in our columns.

CARLIN & FULTON, Baltimore, Md., have recently placed on the market a stone-engraving machine, the invention of D. M. Fulton, a member of the firm. The machine consists of a rotating drill, which is guided by means of a stencil containing the design or lettering to be produced. The machine is said to do rapid and excellent work, and to greatly decrease the cost of stone engraving.

THE EXCELSIOR IRON WORKS CO., of Cleveland, O., is introducing a steam-operated clamshell bucket for handling coal, ore, broken stone, etc., in connection with a steam traveling derrick. It is also introducing a drop-bottom bucket; the bucket is an iron cylinder with the bottom carried by a shaft about 6 to 12 inches off the center so as to give a large opening when the latch is released.

THE BERLIN IRON BRIDGE CO., of East Berlin, Conn., has completed a large number of connecting bridges between the buildings of the Barbour Flax Spinning Co., of Paterson, N. J. It has also completed the additions to the plant of the Westminster Paper Co., of Bellows Falls, Vt., including the new machine room, 40 x 185 ft., covered with the Berlin company's patent anti-condensation corrugated steel roof.

THE MONMOUTH MINING & MFG. CO., of Monmouth, Ill., has been awarded the contract for furnishing all the sewer pipe for the new sewerage system at Peoria, Ill., the contractors of which are T. B. Townsend & Co. It also has the contract for furnishing the pipe for the Averyville, Ill., sewerage system, for which Harman & Evans, of Peoria, are the engineers, and the Talbot Construction Co. has the contract. About 250 carloads will be required for these two contracts.

THE NATIONAL SWITCH & SIGNAL CO., of Easton, Pa., has been awarded the contract for furnishing the interlocking machine at New Rochelle on the New York, New Haven & Hartford R. R. This is a junction point of the four-track main line, and is laid with 100-lb. rails, and as there are two slip switches in the plan, making a 48-lever machine necessary, the work to be performed by this machine will be very severe. The company has placed orders for considerable machinery to meet the requirements of its increasing business. The annual meeting was held on May 6, at which the old officers were elected.

THE MERCHANTS' ASSOCIATION, of San Francisco, Cal., would like to hear from dealers in paving material, manufacturers of street and road machinery, patentees and owners of appliances and machines for the improvement of streets, and all who are interested in such matters, in regard to the holding of a paving exhibition in that city at the time of the Mechanics' Fair, which is an annual exhibition held by the Mechanics' Institute from Aug. 13 to Sept. 13. The Merchants' Association will secure ample space for the paving exhibit. Address all communications to F. W. Dohrman, President of the association, or Ernest McCullough, Consulting Engineer for the association.

THE GILLETTE-HERZOG MFG. CO., Minneapolis, Minn., Frank J. Llewellyn, Vice-Pres. and Ch. Engr., reports a decided improvement in its business. Among the contracts recently obtained are a 400-ft. highway bridge over the Great Northern Ry. at St. Paul, Minn., $31,000; the ironwork for the Lonsdale Bldg., 10 stories, Duluth, Minn., $21,000; Hagan Ave. bridge, New Orleans, La., $11,000; 200-ft. highway bridge, Gladstone, Mich.; Minneapolis & St. Louis R. R. bridge, Tenth Ave., Minneapolis, Minn.; a bag and cotton factory at Atlanta, Ga., and a store and office building, Helena, Mont. The items in our issues of April 4 and 18 regarding the division of the iron roof work for the Minneapolis Court House, Minneapolis, Minn., have given rise to some misunderstanding as to the respective parts of the work done by this company and by the Shiffler Bridge Co. Plans for the entire roof were prepared some time ago, and the plans of the Gillette-Herzog Mfg. Co. adopted by the commissioners. Owing to lack of funds, however, the contract was let to construct only the roof over the county side of the building at that time, and this company secured this contract, which involved the manufacture and erection of some 700,000 lbs. of ironwork. Later the contract for the roof over the city side of the building was let, and this was secured by the Shiffler Bridge Co., involving the construction and erection of about 900,000 lbs. of ironwork.

NEW COMPANIES.—Sonora Copper Co., Jersey City, N. J.; $20,000, all paid in; George W. Mark, New York, N. Y.; Otto C. Heintze, Brooklyn, N. Y.; H. F. Hatch, Orange, N. J.

Pittsburg Illuminating Co., Pittsburg, Pa.; $1,000; gas; Treas., H. McFarland.

Omaha Boiler Mfg. Co., Omaha, Neb.; $200,000; W. S. Felker, H. A. Sherer and J. B. West.

Glenn Driller Co., New Brighton, Pa.; $20,000, with $2,000 paid in; Treas., Frank H. Stuckfield.

Greater Pittsburg Illuminating Gas Co., Pittsburg, Pa.; $10,000,000; Joshua Rhodes, James H. Reed and Parker L. Walter.

Smith & Rouse Splice Bar Mfg. Co., Homestead, Pa.; $1,000,000, with $250,000 paid in; J. E. Smith, E. F. Rouse and John Osborne.

Cleveland Erecting Co., Cleveland, O.; $10,000; erecting bridges, buildings, etc.; R. L. Henry, M. H. McKenna and Virgil P. Kline.

Novaculite Paving Co., East St. Louis, Ill.; $25,000; Robert H. Rosborough, of Sparta, Ill.; Francis M. Gillett and Andrew C. Bryden, of St. Louis, Mo.

Whippany River Construction Co., Jersey City, N. J.; $10,000, with $1,000 paid in; railways; John E. Melick, Morristown, N. J.; John F. Pidcock, Jersey City, N. J.

United States Iron Works Co., Charleston, W. Va.; $50,000, with $1,250 paid in; I. H. Munford and Colin Forbes, of New York, N. Y.; F. K. Fitch, of Brooklyn, N. Y.

Atlantic City Carette Co., Atlantic City, N. J.; $20,000, with $1,000 paid in; omnibus and stage business; Allen B. Endicott, D. B. Edwards and Franklin P. Clark.

Esperanza Quartz Mining Co., San Francisco, Cal.; $2,500,000, with $500 paid in; engines, boilers, etc.; James H. Hoyt, A. C. Dustin and H. A. Kelley, of Cleveland, O.

Mutual Finance & Construction Co., Kearney, N. J.; $100,000, with $1,000 paid in; John H. Carnes, 93 Glenwood Ave., Jersey City, N. J.; George F. Woolston, Jr., Arlington, N. J.

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A FEW WORDS ABOUT PROPOSAL ADVERTISING.

In the 19 issues of Engineering News from Jan. 3 to May 9, there were printed 183 different proposal advertisements, about 400 total insertions, asking for bids for work in over 100 cities and towns. Among the municipal advertisements were the following: Sewers, pipe and pumping engines, at Brooklyn, N. Y.; sewers and bridges, at Providence, R. I.; sewers, paving, etc., at Washington, D. C.; paving (5 advertisements) and water conduit, at Erie, Pa.; paving and sewers, at Peoria, Ill.; laying water pipe (4 advertisements, 13 insertions), at New Orleans, La.; large grading contract, at St. Louis, Mo.; bridge work, at Providence, Cincinnati, Denver, Atlanta, Nashville and other cities; courthouse, at Baltimore, Md.; electric light plants in several cities; water-works construction in all parts of the country, including Astoria, Ore., and Santa Clara, Cal.; and several railway contracts.

Within a few years more than 900 different cities have advertised work in this paper, and many cities now advertise all their work in Engineering News, where it is brought to the attention of prominent contractors in every part of the United States. These advertisements cost less than similar notices in daily papers, and prove the most economical, as well as the most efficient, method of bringing work to the attention of desirable parties. Thus they not only save in the cost of the advertising, but the publicity given to work noted in these columns causes increased competition and lower bids.

Every city that advertises work in this paper saves money by so doing. Every engineer should see that his work is advertised in Engineering News.

An engineer writes that more than 150 replies were received from a recent insertion of a water-works advertisement in Engineering News. It would have taken a large number of daily papers and cost a considerable sum of money to have secured this result by the old-fashioned method of advertising work only in daily papers.

Engineering News prints more reliable news items, a larger number of proposal advertisements, and is much more extensively read by contractors and manufacturers of contractors' supplies than any other paper in America. These facts should be borne in mind. They may save you or your city large sums of money on contracts.

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